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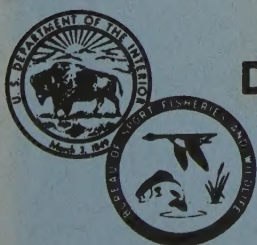
SPORT FISHERY ABSTRACTS

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SPORT FISHERY ABSTRACTS

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Sport Fishery Abstracts is intended to furnish fishery biologists with abstracts of current literature in sport fishery research and management.

One volume, consisting of four numbers, is issued each year. Each number contains separate Author, Geographic, and Taxonomic indexes, and the final number of each volume contains cumulative Author, Geographic, Taxonomic, and Subject indexes, and a list of publications screened. Authors who publish in journals not screened for *Sport Fishery Abstracts*, and who would like their publications included, should submit abstracts to the Editor.

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SPORT FISHERY ABSTRACTS

An abstracting service for fishery research and management

Volume 20 Number 4

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AQUATIC PLANTS AND THEIR CONTROL

75-000349 Buck, D. H.; Baur, R. J.; Rose, C. R. (Ill. Nat. Hist. Surv., Kimmunity 62854) COMPARISON OF THE EFFECTS OF GRASS CARP AND THE HERBICIDE DIURON IN DENSELY VEGETATED POOLS CONTAINING GOLDEN SHINERS AND BLUEGILLS. Prog. Fish-Cult. 37 (4): 185-190. Oct. 1975. SFA 20 (4).

The study was conducted over the period May to September 1973 in twenty 3.048-m-diameter pools having soil substrates and stocked with either filamentous algae or five species of common macrophytes. All pools were stocked with fingerling bluegills (*Lepomis macrochirus*) and golden shiners (*Notemigonus crysoleucas*). Four of the 8 algal pools were stocked with white amur, 4 were left as controls; 4 of the 12 weedy pools were stocked with white amur, 4 were treated with the herbicide diuron, and 4 were left as controls. Final censuses were made of the live weight of the fish and dry weight of the plants in kilograms per hectare. Comparative reductions in standing crops of plants were 92 percent by the herbicide, 79 percent by the white amur. The white amur reduced the filamentous algae by 99 percent, totally eliminated both species of *Najas* and *Potamogeton*, but consumed relatively little coontail. Neither the presence of the white amur nor the use of the herbicide had any measurable influence upon the growth or reproduction by the bluegills or golden shiners.

75-000350 Rawls, C. K. (Chesapeake Biol. Lab., Univ. Md., Solomons 20688) MECHANICAL CONTROL OF EURASIAN WATERMILFOIL IN MARYLAND WITH AND WITHOUT 2,4-D APPLICATION. Chesapeake Sci. 16 (4): 266-281. Dec. 1975. SFA 20 (4).

Eurasian watermilfoil (*Myriophyllum spicatum* L.) increased from a minor annoyance of a few thousand acres in the late 1950's, to a major nuisance covering over 200,000 acres in waters of the upper portion of the Chesapeake Bay in 1964. From 1961 through 1964, the effectiveness of underwater mowing of milfoil using a mechanical mower with and without subsequent application of 2,4-dichlorophenoxyacetic acid was investigated in medium and near maximum salinity ranges for milfoil in tributaries of Maryland's western shore. Milfoil normally reaches the surface by early May, and begins to sink in high salinity waters about September 15, and in lower salinities about October 15. Depending on the type of activity for which milfoil control is instituted, mowing must be repeated at least monthly during the usual mid-May to mid-September growing season. In this study it was effective only for the season in which it was made. New nodal growth to 18 inches or more per month from cut milfoil stems or fragments made cutting impractical for large areas. Cutting followed by herbicide application when new growth offered sufficient vegetative containment of applied 2,4-D impregnated attack granules extended milfoil's vulnerable period to 2,4-D beyond anthesis. The butoxyethanol ester of 2,4-D was more effective than the iso-octyl ester. In study plots no adverse affects were noted to endemic fauna. Prime submersed waterfowl food plants, previously retarded by the dense milfoil over-story, made rapid growth once the milfoil was thinned or removed. These preferred waterfowl foods

75-000350 CONTINUED

evidenced no undesirable responses to either cutting or to 2,4-D.

GENERAL FISH CULTURE

75-000351 Anon. L'ALLEVAMENTO INTENSIVO DI VITELLI E POLLAME E ATTIVITA AGRICOLA. [INTENSIVE CALF AND POULTRY BREEDING IS AGRICULTURAL ACTIVITY.] Riv. It. Piscic. Ittiop. 10 (2): 39-40. Apr.-May-June 1975. In Italian with English summ. SFA 20(4).

Trout farming in Italy is often considered as an industrial activity. Italian trout farmers proposed, since long, to be included in agriculture since they are growing animals. The article comments a judgement issued by the court of Novara, Italy, on a case that can be compared with trout farming, i.e. intensive poultry and calf breedings. They were considered as agricultural, and not as industrial, activity. (Auth. Summ.)

75-000352 Veronesi, G. INQUINAMENTO DA PISCICOLTURE NEL DIRITTO VIGENTE IN ITALIA (NORME STATALI, REGIONALI, E LOCALI). [POLLUTION FROM FISH FARMS IN CURRENT LAW IN ITALY (/STATE, REGIONAL AND LOCAL RULES/).] Riv. It. Piscic. Ittiop. 10 (2): 37-39. Apr.-May-June 1975. In Italian with English summ. SFA 20(4).

Water pollution deriving from fish farms is considered by the author in the frame of laws existing in Italy on the subject. The rules that are operating in the Region Lombardia, Italy, and that must be followed in establishing and conducting trout farms are briefly commented. These rules aim to avoid any water pollution and also to respect the landscape. (Auth. Summ.)

TROUT AND SALMON CULTURE

75-000353 Thatcher, T. O.; Wolf, E. G.; Schneider, M. J. (Battelle Mar. Res. Lab., Rt. 2, Box 140, Sequim, WA 98382) FURTHER SUCCESS IN THE DEVELOPMENT OF LABORATORY TECHNIQUES FOR SPAWNING BROOK TROUT, /SALVELINUS FONTINALIS/. Prog. Fish-Cult. 37 (4): 245-247. Oct. 1975. SFA 20(4).

Young-of-the-year brook trout (/Salvelinus fontinalis/) were successfully spawned in small laboratory aquaria employing inexpensive and quickly constructed spawning baskets. Numbers of spawnings and egg production appeared comparable to those achieved with much more elaborate systems. Temperature control, maintained between 9° and 12° C throughout the year appeared to be the prime factor enabling the early spawning.

75-000354 Thomas, A. E. (U.S. FWS, Fish Farming Exp. Stn., Stuttgart, AR 72160) EFFECT OF EGG DEVELOPMENT AT PLANTING ON CHINOOK SALMON SURVIVAL. Prog. Fish-Cult. 37 (4): 231-233. Oct. 1975. SFA 20(4).

Eggs of chinook salmon (/Oncorhynchus tshawytscha/) were planted in the Abernathy incubation channel in three stages of development as (1) unwaterhardened, (2) waterhardened, and (3) eyed. Percentage survivals to the migrant fry stage were 50.1, 37.6, and 73.4, respectively, during the 1967-68 season, and 75.8, 60.2, and 77.5 during the 1968-69 season. High water temperature was the probable cause of the lower survival of both lots of green eggs in 1967-68 than in 1968-69.

75-000355 Zirges, M. H.; Curtis, L. D. (Fish. Comm. Oreg., Elk R. Salmon Hatchery, Port Orford 97465) AN EXPERIMENTAL HEATED-WATER INCUBATION SYSTEM FOR SALMONID EGGS. Prog. Fish-Cult. 37 (4): 217-218. Oct. 1975. SFA 20(4).

An experimental heated-water incubation system was constructed to speed up embryonic development of eggs of fall chinook salmon, (*Oncorhynchus tshawytscha*). Heavy sac-fry mortality occurred soon after hatching in early tests. This apparently resulted from dissolved gas supersaturation and heavy metal ion contamination induced by the heating system. These two problems were corrected by constructing an aerator and coating the heating elements with Teflon II, respectively. Hatching success was good in the modified system and heating reduced time to ponding by 30 days compared to unheated water.

WARMWATER CULTURE

75-000356 Banner, A.; Hyatt, M. (U.S. FWS, Box 2676, Vero Beach, FL 32960) INDUCED SPAWNING OF BLUEGILL SUNFISH. Prog. Fish-Cult. 37 (4): 173-180. Oct. 1975. SFA 20(4).

Methods were developed to acquire gametes from bluegill sunfish (*Lepomis macrochirus*) at various times of year. Reproductive activity was enhanced by exposure to prolonged photoperiod and elevated temperatures similar to those of the normal reproductive season. Males then released sperm when stripped, but females required additional treatment before viable eggs could be obtained. Egg maturation was promoted by periodic injection of hormone materials, particularly carp pituitaries, and temperature cycling. More frequent application of carp pituitary material to treated females resulted in simultaneous ovulation by several donor fish.

75-000357 Bauman, M. A.; Metter, D. E. (Dep. Zool., Univ. Mo., Columbia 65201) ECONOMICS, FEEDING, AND POPULATION STRUCTURE OF /NATRIX S. SIPEDON/ IN A GOLDFISH HATCHERY. Prog. Fish-Cult. 37 (4): 197-200. Oct. 1975. SFA 20(4).

Predation in goldfish hatcheries by the Northern Watersnake /*Natrix s. sipedon*/ causes enough economic damage to justify control measures by the hatchery. At Ozark Fisheries Inc., the snakes known to have been killed each year are capable of eating over \$80,000.00 worth of goldfish during the year. The damage done by the surviving snakes is undoubtedly high but cannot be accurately estimated.

Persecution of /*Natrix s. sipedon*/ results in a younger age class distribution of the population than would be expected where normal predation on the snake was exerted.

Systematic killing of the species keeps /*Natrix s. sipedon*/ from increasing its numbers on a hatchery. However, eradication of the species is impossible by the methods used at Ozark Fisheries and the population is maintained at a level below the carrying capacity. (Auth. Concl.)

75-000358 Davis, R. J.; Finni, G. R. (Dep. Biol., Allegheny Coll., Meadville, PA 16335) LABORATORY MAINTENANCE OF DARTERS (PERCIDAE: /ETHEOSTOMA/ SSP. Prog. Fish-Cult. 37 (3): 170. July 1975. SFA 20 (4).

75-000359 Ghittino, P.; Vigliani, E. (Ist. Zooprofil. Sperim., Via Bologna, 148-10154 Torino, Italy) DIFFICOLTA DI DECOLLO DELLA PESCI GATTOCOLTURA ITALIANA. [DIFFICULT TAKE-OFF OF CATFISH FARMING IN ITALY.] Riv. It. Piscic. Ittiop. 10 (2): 45-51. Apr.-May-June 1975. In Italian with English summ. SFA 20 (4).

The authors discuss the problems that catfish farming, just recently exploited, is facing in Italy. They affirm that it is a possible, economic, and suitable kind of intensive fish farming in warm-water ponds. Obvious references are made to the success that catfish farming achieved in the USA.

Two catfish species are present in Italy and they were previously imported from North America, namely the black bullhead (/Ictalurus melas/) (also called "Italian") and the brown bullhead (/Ictalurus nebulosus/) (also called "Slav"). The authors characterize and differentiate such two species with original drawings and pictures.

An act (R. D. March 2, 1931, N. 42) in Italy is forbidding any trade of alive catfish; this act was passed when the species (once considered single, i.e. /I. nebulosus/) was regarded as extremely noxious to the fish fauna living in the Italian waters and also without value at all.

Water pollution pretty soon nearly eliminated this fish from the free-waters and the concerned demand by some Italian fish markets increased; a raise of price followed and an interest to farm it arose. Italian fish market demands alive catfish of 150-200-250 gr. bodyweight.

The authors describe the method applied in Italian catfish farming and discuss the problems and the possible future development of this operation. A particular attention is paid to the needs of: abrogation of the 1931's act, control of artificial reproduction, of marketing, of the diseases of farmed catfish. Only if such factors will be controlled, the future of catfish farming will be successful also in Italy.

75-000360 Kempinska, H. (Akad. Roln., Warsaw, Poland) WPLYW INTENSYWNOŚCI SELEKCJI NA LACZEBNOŚĆ SAMIC I SAMCÓW KARPIA W POSZCZEGÓLNYCH KLASACH WIEKU. [THE EFFECT OF SELECTION INTENSITY UPON THE NUMBER OF CARP FEMALES AND MALES IN PARTICULAR AGE CLASSES.] Roczn. Nauk Roln. Ser. H Rybactwo 96 (3): 57-74. 1974. In Polish with English summ. SFA 20 (4).

In the inbred selection carp populations it was investigated the number of females and males in the age classes K(1)-K(4) having the live weight equal or higher than C mean $\bar{x}$, C mean $\bar{x} + s$ and C mean $\bar{x} + s$ times $t(.05)$. It was investigated as well the number of carps that were remaining in these groups of weight for two, three and four years of life. (Auth. Synopsis)

75-000361 Kirpichnikov, V. S., ed. SELECTIVE BREEDING OF CARP AND INTENSIFICATION OF FISH BREEDING IN PONDS. Izv. Gos. Nauchno-Issled. Inst. Ozer. Rech. Rybn. Khoz. 61: iv + 249p. 1966. Translation available from U.S. Department of Commerce, Clearinghouse for Federal Scientific and Technical Information, Springfield, VA 22151. SFA 20 (4).

A collection of 20 papers, the primary aim of which is to state the theoretical principles of carp selection. Articles on intensification of pond pisciculture are also included. (RS)

75-000362 Opuszynski, K.; Bieniarz, K. STAN OBECNY I PERSPEKTYWY ROZRODU I PODCHOWU RYB CIEPLOLUBNYCH W WARUNKACH SZTUCZNYCH. [PRESENT STATE AND PROSPECTS FOR WARM WATER FISH REPRODUCTION AND SEEING THROUGH THE FIRST STAGES OF THEIR GROWTH UNDER ARTIFICIAL CONDITIONS.] Roczn. Nauk Roln. Ser. H Rybactwo 96 (3): 27-43. 1974. In Polish with English summ. SFA 20(4).

Possibility of large scale reproduction of warmwater fish under artificial conditions as the results of recent findings of science and technique. Profits resulting from this and the principal problems connected with the environment control and the stimulation of maturity by hormones. Economic necessity of treating jointly the reproduction and hatch rearing under artificial conditions. Problems connected with hatch rearing with particular consideration of carp. (Auth. Synopsis)

75-000363 Reich, K. (The Hebrew Univ., Dep. Zool., Jerusalem, Israel) MULTISPECIES FISH CULTURE (POLYCULTURE) IN ISRAEL. Bamidgeh 27 (4): 85-99. Dec. 1975. SFA 20(4).

1. Raising of a number of fish of the same species in a pond rises the intraspecific competition and decrease their individual growth.
2. Polyculture, even of fish which feed on different natural food causes always a certain amount of interspecific competition. At the same time, the fish influence their surroundings. These changes can improve the growth conditions for other species or worsen them.
3. The yield of each component fish species, and as a result of this the yield of the entire pond is the resultant of the various influences that act in different directions, to both diminishing and increasing the yield.
4. The most successful combination of fish species in a pond that gives the largest yields is one in which the extent of interspecific competition is the smallest and the total of influences improving the pond conditions the largest.
5. In the polyculture of three species: carp, s. carp, and tilapia we created a balanced ecological system in which the interspecific competition is small and improvement of the environment large. It enables us to rise the population density above that customary in monoculture and at the same time maintain a high individual growth of the fish. (From Auth. Summ.)

75-000364 Satchell, D. P.; Crawford, S. D.; Lewis, W. M. (Sch. Agric. Fish. Res. Lab., South. Ill. Univ., Carbondale 62901) STATUS OF SEDIMENT FROM CATFISH PRODUCTION PONDS AS A FERTILIZER AND SOIL CONDITIONER. Prog. Fish-Cult. 37 (4): 191-193. Oct. 1975. SFA 20(4).

By chemical analysis and test plots the sediment from channel catfish (*Ictalurus punctatus*) production ponds was evaluated as a fertilizer and soil conditioner. The results indicated that the sediment can not be considered a fertilizer or conditioner, but at best falls in the category of rich soil.

75-000365 Schroeder, G. L. (Fish Aqua-Cult. Res. Stn., Dor, Israel) NIGHTTIME MATERIAL BALANCE FOR OXYGEN IN FISH PONDS RECEIVING ORGANIC WASTES. Bamidgeh 27 (3): 65-74. Sept. 1975. SFA 20(4).

Intensely manured ponds receiving no supplemental feed give yields of greater than 30 kg. fish per hectare per day, throughout the growing season. The quantity of manuring required to attain such high yields of fish without food, produces a delicate balance between oxygen production and consumption. Measured parameters including pond water BOD, pond bottom BOD, rates of manuring, stocking density of

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fish, and calculations of oxygen consumption by fish, permitted evaluation of factors significant in the material balance for oxygen during the crucial nighttime hours. The factors include oxygen transfer across the pond surface-air interface and the amount of oxygen added by artificial aeration.

For water temperature of 30°C, manuring a 1m deep pond at a daily rate of 1000 liters manure (containing 125 kg. dry matter) per hectare causes an initial overnight decrease in dissolved oxygen of 0.3 ppm. A cumulative depression of 1.5 ppm may be observed in the first days of manuring. The added nutrients contained in the manure usually increase photosynthetic production so that the steady state DO of a properly manured pond is often higher than the DO in a comparable non-manured pond. BOD of the pond water ranged from 3 to 17 ppm and showed no correlation with plankton and suspended organic matter retained on 150 micron or 50 micron nets. Net overnight losses of DO across the pond-air interface exceeded 4 ppm for ponds having late afternoon DO concentrations greater than 200 percent saturation. BOD of fish pond bottoms ranged from 1 to 3 g. oxygen per square meter of pond bottom. In a 1 meter deep pond, this will lower the DO of the water 0.5 to 1.5 ppm per 12 hours.

75-000366 Smith, W. E. (U.S. EPA, Environ. Res. Lab., Duluth, MN 55804) BREEDING AND CULTURE OF TWO SUNFISH, /LEPOMIS CYANELLUS/ AND /L. MEGALOTIS/, IN THE LABORATORY. Prog. Fish-Cult. 37 (4): 227-229. Oct. 1975. SFA 20(4).

Green sunfish (/Lepomis cyanellus/) and longear sunfish (/Lepomis megalotis/) were spawned in the laboratory, the embryos hatched, and larval fish fed successfully on San Francisco brine shrimp nauplii. Green sunfish were reared to sexual maturity and spawned at 16 wk from hatch. Longear sunfish required 22 wk to mature. The cultural techniques employed are discussed.

75-000367 Worsham, R. L. (USDA, Water Qual. Manage. Lab., Durant, OK 74701) NITROGEN AND PHOSPHORUS LEVELS IN WATER ASSOCIATED WITH A CHANNEL CATFISH (/ICTALURUS PUNCTATUS/) FEEDING OPERATION. Trans. Am. Fish. Soc. 104 (4): 811-815. Oct. 1975. SFA 20(4).

Nitrogen and phosphorus budgets for two catfish raceways near Durant, Oklahoma, during 1972 and 1973, indicated that 18 to 64 percent of the total nutrient inputs accumulated in the raceways' sediment. Both N and P inflow/outflow levels were relatively constant throughout the study. Levels of nitrite-N, nitrate-N, ammonium-N, and organic-N were generally higher in the outflow than the inflow, but were typically within recommended water quality limits. Similarly, average total and soluble P concentrations increased in the raceways, doubling from inflow to outflow. Nevertheless, the increased N and P levels did not result in serious problems due to algae or other aquatic growths. Moreover, the health and growth of the catfish remained good. Present raceway management and catfish production practices seem to pose no particular water quality problem.

MARICULTURE

75-000368 Ghittino, P.; Glenn, J. S.; Smith, F. G. (Ist. Zooprofil. Sperim. Via Bologna, 148-10154 Torino, Italy) STUDIES ON HORMONAL INDUCTION OF GONADAL DEVELOPMENT IN AMERICAN EEL (*ANGUILLA ROSTRATA*). Riv. It. Piscic. Ittiop. 10 (3): 75-85. July-Aug.-Sept. 1975. In English with Italian summ. SFA 20(4).

The authors stressed the importance of obtaining artificial fertilization in eel. The problem still has scientific and practical interests, from eel embryology and life cycle, to eel culture.

In October 1972, a group of 133 silver American eel (*Anguilla rostrata*), ranging in average size from 30 cm. (62 males) to 80 cm. (71 females) from freshwater tributaries of the Chesapeake Bay (USA), were put in laboratory tanks supplied with dechlorinated city tap water. The purpose of the research was to study the hormonal induction of artificial maturation of both eel sexes and to obtain an artificial insemination in the species. Several accidents and diseases greatly reduced the number of eels to be utilized in the study. Nevertheless, the authors were able to study the effect of some hormones on male and female eels.

Small groups of eels were transferred into tanks and aquaria with artificial sea water (35‰ salinity) which was filtered and recirculated. Temperature was governed by room temperature and it ranged from 20-24° C. Eel were never fed and received weekly injections in the connective tissue of the dorsal fin. The experimental period extended for 3-4 months. Survival was poor in females, better in males.

Males were injected with Chorionic Gonadotropin (CG) commercial preparations at the rate of 500 IU per fish. Within a month, after 45 injections, males turned dark, with black pectoral fins, white round abdomen, enlarged eyes and they produced sperm if lightly stripped. Testes were histologically examined from the Syrski-organ stage to the active lobular glands.

Female eel were injected with CG products (A.P.L., Vetrophin, A.P.L. + diethylstilbestrol, acetone-dried carp hypophysis, A.P.L. + carp hypophysis). Only carp hypophysis preparations were able to induce a significant increase in the eel ovary. Histologically, egg diameter increased from 130-300 u (untreated eel or treated with products other than carp hypophysis) to 490-637 u (eel injected with carp hypophysis alone or after A.P.L.). This growth was obtained within 2.5 months after 15 injections. The authors tried in a few cases the artificial insemination of some eggs but without success.

The authors concluded that in male silver American eel, sperm was easily obtained in a shorter time (1-1.5 mo.) than in experiments previously referred in the literature (2 mo.). Female eel were stimulated, with a good increase of egg diameter, only if injected with carp hypophysis.

FEEDS, FEEDING AND NUTRITION

75-000369 Brett, J. R.; Shelbourn, J. E. (Fish. Mar. Serv., Pacific Biol. Stn., Nanaimo, BC V9R 5K6, Canada) GROWTH RATE OF YOUNG SOCKEYE SALMON, *ONCORHYNCHUS NERKA*, IN RELATION TO FISH SIZE AND RATION LEVEL. J. Fish. Res. Board Can. 32 (11): 2103-2110. Nov. 1975. In English with French summ. SFA 20(4).

The specific growth rate of young sockeye salmon (*Oncorhynchus nerka*) was studied for a period of 7 mo to determine the effect of body weight when on restricted and unrestricted rations. It was hypothesized that a restricted ration would result in a fixed growth rate until size became a limiting factor reducing food demand below

75-000369 CONTINUED

the prescribed level and thereby reducing growth rate. The results support the hypothesis, with the possible exception that growth rate may increase slightly during the period of fixed ration. On excess ration the specific growth rate fell from 3.6 percent weight per day (2.4 g mean weight) to 1.0 percent weight per day (37 g mean weight); intermediate constant growth rates accompanied the periods of fixed ration, inflecting to lower rates subsequently. The general equation $\log G = /a/ + /b/ \log W$ (where g = specific growth rate, and W = weight in grams) was found to apply to a number of salmonids. The slope value of $/b/ = -0.4 \pm .04$ appears to characterize the family, with the intercept $/a/$ taking on different values according to the varying capacity for rapid growth.

75-000370 Ghosh, S. R. (Cent. Inland Fish. Res. Sub-Stn., 19 Cantoment Rd., Cuttack-1 (Orissa), India) PRELIMINARY OBSERVATION ON THE EFFECT OF COBALT ON THE SURVIVAL AND GROWTH OF /MUGIL PARSIA/. Bamidgheh 27 (4): 110-111. Dec. 1975. SFA 20(4).

Young fry of /Mugil parsia/ responded to addition of cobalt chloride dietary additions with improved growth and survival. Optimal cobalt dosages were 0.6-1.0 ppm. (RS)

75-000371 Horoszewicz, L. PRZEŻYWAŁNOŚĆ WYLEGU KARPIA GŁODUJĄCEGO W WODZIE O RÓŻNEJ TEMPERATURZE. [SURVIVAL OF CARP FRY STARVING IN WATER OF VARIOUS TEMPERATURE.] Roczn. Nauk Roln. Ser. H Rybactwo 96 (3): 45-56. 1974. In Polish with English summ. SFA 20(4).

Comparison of survival of carp hatch 3 and 14 days old starving at a room temperature of 18-23°C, and at constant temperatures of 25, 27, 30 and 32°C. In two series of experiment the survival rate of hatch was found to decrease with an increase of temperature from 18° to 30°C. At a temperature of 32°C the survival rate was similar as at 30°C. Results of investigation into body weight losses in hatch starving at room temperature performed at the very moment when 50 percent of fish batch were dead, as well as into ability of remaining specimens for growth and development under food excess conditions. (Auth. Synopsis)

75-000372 Ketola, H. G. (U.S. FWS, Tunison Lab. Fish Nutr., Courtland, NY 13045) REQUIREMENT OF ATLANTIC SALMON FOR DIETARY PHOSPHORUS. Trans. Am. Fish. Soc. 104 (3): 548-551. July 1975. SFA 20(4).

Triplicate lots of young Atlantic salmon (/Salmo salar/) were fed a diet containing graded levels of supplemental inorganic phosphorus. The basal diet, containing mainly dehulled soybean meal and other plant materials, provided 40 percent crude protein, 0.7 percent phosphorus, 1.5 percent calcium, and 4,000 IU of supplemental cholecalciferol per kg of diet. Supplements of inorganic phosphorus significantly improved growth, feed utilization, and bone ash content. Inorganic phosphorus supplementation up to 0.6 percent of the diet increased growth rate and bone ash content; additions beyond this level had little further effect. This study suggests that when young salmon are fed diets containing 0.7 percent phosphorus from plant sources, the minimum requirement for supplemental inorganic phosphorus is approximately 0.6 percent of the diet.

75-000373 Lu, J. D.; Kevern, N. R. (Dep. Fish. Wildl., Mich. State Univ., East Lansing 48824) THE FEASIBILITY OF USING WASTE MATERIALS AS SUPPLEMENTAL FISH FEED. Prog. Fish-Cult. 37 (4): 241-244. Oct. 1975. SFA 20(4).

Sewage sludge and dried poultry waste were studied as supplemental fish feed because of their potentially high nutrient value. Feed, consisting of 30 percent sewage sludge or of different percentages of dried poultry waste, was given to goldfish (*Carassius auratus*) and channel catfish (*Ictalurus punctatus*). Comparisons of diet treatments among different groups of fish were based on monthly percent growth in body weight. Goldfish fed 30 percent sewage sludge diet or 30 percent dried poultry waste grew better than controls (Ewos F49), while catfish given feeds consisting of 30 percent, 70 percent, and 100 percent dried poultry waste in each of three feeding levels displayed significantly lower growth rates than controls (Ewos F49). Feed given at 2 percent of body weight appeared to offer the most efficient conversion for catfish fingerlings.

75-000374 Marek, M. (Minist. Agric., Dep. Fish., Tel-Aviv, Israel) REVISION OF SUPPLEMENTARY FEEDING TABLES FOR PONDFISH. Bamidgah 27 (3): 57-64. Sept. 1975. SFA 20(4).

1. It is important to note that the effect of natural food decreases and becomes a limiting factor in the daily ration in ponds of high density. Since the supplementary food we use is not perfect, the result is a great drop in the individual growth rate, at high densities.

2. It is possible to obtain reasonable feed conversion ratios with large fish (above 300 g.) in high densities (20000-50000 fish per ha) provided the food portion is adjusted to the growth rate.

3. High stocking rates shorten the length of the period of optimal growth, probably due to some inhibitory factors. It may be that in the future we can overcome this problem by using chemical or other means.

4. We have not yet found a way of raising small fish (up to 300 g.) in high densities while keeping the feed conversion ratios at a reasonable level. We must search for a solution to this problem in several directions: a) increasing the fertility of the pond; b) adjusting the composition of the pellets to small fish; c) supplying natural food from an outside source.

5. The purpose of the feeding tables are to assist the fishermen and not to replace them. One can not use tables in a helpful way without subjecting them to criticism. (Auth. Summ.)

75-000375 Poston, H. A. (U.S. FWS, Tunison Lab. Fish Nutr., Cortland, NY 13045) INFLUENCE OF DIETARY PROTEIN AND ENERGY ON SWIMMING STAMINA, GROWTH, AND BODY COMPOSITION OF BROWN TROUT. Prog. Fish-Cult. 37 (4): 257-261. Oct. 1975. SFA 20(4).

Six semipurified diets containing 16 to 74 percent fish protein, 10 to 60 percent cellulose, 1.5 to 4.3 available kcal/g, and with energy/protein (E/P) ratios ranging from 4 to 19, were fed for 18 wk to fingerling brown trout (*Salmo trutta*). Increases of dietary protein up 70 percent resulted in increased growth. Level of dietary energy was negatively correlated with intake of diet, and was positively correlated with percentage body fat. Feed fed (g)/gain (g) was negatively correlated with level of dietary protein.

Trout fed a diet with an E/P ratio of 8 or greater consumed less protein (as a percent of body weight) and had less stamina than those fed a diet with an E/P ratio of 6 or less. Trout with the lowest stamina had consumed less protein than those with greater stamina. Fish stamina was not significantly correlated with size of body, intake of diet, or level of dietary cellulose.

75-000376 Rapoport, U.; Sarig, S. (Genosar Sub-Station, Genosar, Israel) THE RESULTS OF TESTS IN INTENSIVE GROWTH OF FISH AT THE GENOSAR (ISRAEL) STATION PONDS IN 1974. *Bamidgeh* 27 (3): 75-82. Sept. 1975. SFA 20(4).

1. When carp is grown at a density of 50000 fish per ha and fed standard feed, there is an increase in weight from 9 to 450 g and there is a yield of 30 tons for 200 growth days.

2. Ad lib feeding results in an increased FCR of 13-29 percent as compared to that for standard feed.

3. A feed ration reduced to 38 percent of the standard feed has a negative effect on small fish but a positive effect of carp weighing 400 g and more.

4. Feed composed of sorghum exclusively results in a decreased catch and an increased FCR as compared to pellets both for small carp and more pronouncedly during the second season for large carp.

5. Feed containing 50 percent pellets and 50 percent sorghum gave good results during the second season for large carp. The advantage was less obvious during the first season small carp.

6. Growth of tilapia at a density of 20000 and 80000 fish per ha with an initial weight of 150 g gave surprising results. The individual growth for both densities did not change and the catch for the higher density was between 33 and 36 tons per ha for 200 growth days.

7. Chemical analyses of the pond bottom soils showed large quantities of phosphorous present in the upper soil layer. The phosphorous slowly re-enters the water and it has been clearly shown that in these cases, phosphorous fertilizers are totally unnecessary.

8. An examination of the level of ammonia nitrogen revealed extremely low concentrations thereby eliminating nitrogen as the limiting growth factor. (Auth. Summ.)

75-000377 Rumsey, G. L.; Ketola, H. G. (U.S. FWS, Tunison Lab. Fish Nutr., Cortland, NY 13045) PRACTICAL DIETS FOR ATLANTIC SALMON (*SALMO SALAR*.) FRY AND FINGERLINGS. *Prog. Fish-Cult.* 37 (4): 253-256. Oct. 1975. SFA 20(4).

Experiments were conducted with swim-up fry and fingerling Atlantic salmon (*Salmo salar*.) to compare high-cost imported commercial diets with practical diets formulated using domestic feedstuffs. The results showed that nutritionally satisfactory diets can be manufactured using conventional commercially available ingredients at a cost much lower than that of the imported diets.

75-000378 Shaw, H. M.; Saunders, R. L.; Hall, H. C.; Henderson, E. B. (32 Bulkara Rd., Bellevue Hill, N.S.W. 2023, Australia) EFFECT OF DIETARY SODIUM CHLORIDE ON GROWTH OF ATLANTIC SALMON (*SALMO SALAR*.) J. Fish. Res. Board Can. 32 (10): 1813-1819. Oct. 1975. In English with French summ. SFA 20(4).

Growth and food conversion efficiency in Atlantic salmon smolts (*Salmo salar*.) in either fresh water or sea water were not demonstrably affected by varying the level of dietary sodium chloride. Large dietary salt loads were almost completely absorbed from the gastrointestinal tracts of fish within 24 h, and plasma sodium and chloride concentrations were positively affected at this time.

Irrespective of whether fish were undergoing random, spontaneous activity or an enforced, uniform low level of activity, growth rates and food conversion efficiencies were similar when fish were fed the same ration but different amounts of sodium chloride.

A possible explanation is that normal renal function in fresh water provides for large amounts of hypoosmotic urine in which excess sodium chloride may be discharged without great expenditure of energy.

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However, in sea water, where urine flow is minimal, the main route of excretion for the excess electrolytes is across the gills, a process requiring energy.

75-000379 Wojno, T. (Akad. Roln.-Tech., Olsztynie, Poland) WYNIKI PROBY TUCZU PSTRAGA TECZOWEGO W SADZACH PRZY ZASTOSOWANIU ROZNEGO RODZAJU PASZ. [RESULTS OF RAINBOW TROUT FEEDING TEST PERFORMED IN NET CAGES USING VARIOUS FEEDINGSTUFFS.] Roczn. Nauk Roln. Ser. H Rybactwo 96 (3): 139-153. 1974. In Polish with English summ. SFA 20(4).

Rainbow trout feeding test in net cages made of steelon cord and installed in a lake. In the feeding test various mixed feeds were used. The survival rate in the rainbow trout tested was from 78.08 to 91.98 percent and depended on the kind of mixed feed applied. The fish body weight increase was found to be satisfactory. (Auth. Synopsis)

TRANSPORTING FISH

75-000380 Otwell, W. S.; Merriner, J. V. (Dep. Food Sci., N.C. State Univ., Raleigh 27607) SURVIVAL AND GROWTH OF JUVENILE STRIPED BASS, /MORONE SAXATILIS/, IN A FACTORIAL EXPERIMENT WITH TEMPERATURE, SALINITY AND AGE. Trans. Am. Fish. Soc. 104 (3): 560-566. July 1975. SFA 20(4).

A 3n factorial experiment to evaluate the effects of an abrupt transfer of striped bass, /Morone saxatilis/, from a closed system rearing facility into a variety of experimental temperature and salinity combinations demonstrated a considerable hardiness of juvenile fish. Striped bass less than two months old had over 80 percent survival during seven days subsequent to acute introduction from the rearing facility into temperatures of 18 C or 24 C and salinities of 4 ppt or 12 ppt. Relative growth in these treatments was monitored, and the results suggest a degree of flexibility for stocking programs into estuaries.

AQUARIUMS

75-000381 Korn, S. (NMFS, P.O. Box 155, Auke Bay, AK 99821) SEMICLOSED SEAWATER SYSTEM WITH AUTOMATIC SALINITY, TEMPERATURE, AND TURBIDITY CONTROL. NOAA Tech. Rep. NMFS SSRF-694. iii + 5p. Sept. 1975. SFA 20(4).

The new seawater system at the Southwest Fishery Center, Tiburon Laboratory, is described. The system delivers up to 450 l/min of filtered, ultraviolet sterilized, temperature- and salinity-controlled seawater suitable for extended holding of marine fish and invertebrates. Unique aspects of the system including provisions for open and/or closed circulation, and the pneumatic salinity control components are described in detail. The design of this facility may offer ideas to others desiring near-oceanic quality seawater from marginal sources.

MISCELLANEOUS CULTURE TECHNIQUES AND EQUIPMENT

75-000382 Brauhn, J.; Hamel, K.; Kohler, B.; Miller, D. (U.S. FWS, Fish Genetics Res. Lab., Beulah, WY 82712) A PORTABLE HIGH-PRESSURE CLEANER FOR TANKS AND RACEWAYS. Prog. Fish-Cult. 37 (4): 234-235. Oct. 1975. SFA 20(4).

The unit described, which was constructed from a portable commercial automobile washer and a 3-hp gasoline motor at a cost of less than \$400, effectively removes algae and debris from circular tanks and concrete raceways. Steel and fiber glass tanks were cleaned at a rate of 1.2 square m/min and concrete raceways at 0.4 square m/min. This unit saves time, can be operated safely, and reduces the work required for a necessary fish-cultural task.

75-000383 Brauhn, J. L.; Schoettger, R. A. (U.S. FWS, Fish-Pesticide Lab., Columbia, MO 65201) ACQUISITION AND CULTURE OF RESEARCH FISH: RAINBOW TROUT, FATHEAD MINNOWS, CHANNEL CATFISH, AND BLUEGILLS. U.S. Environ. Prot. Agency Ecol. Res. Ser. EPA-660/3-75-011. vi + 46p. May 1975. SFA 20(4).

Rainbow trout (*Salmo gairdneri*), channel catfish (*Ictalurus punctatus*), fathead minnows (*Pimephales promelas*), and bluegills (*Lepomis macrochirus*) are cultured widely for toxicological research. However, cultural conditions are sometimes suspected of compromising the test animals and, thus, results of research findings. Because optimum conditions for indoor maintenance and culture of the four species are not well defined, we have adopted standardized practices that are intended to reduce cultural conditions to a common variable status. Water quality, nutrition, genetic variation, diseases, fish handling, gross behavior, and required facilities are discussed. Well known propagation techniques provide the basis for the intensive care methods used. Special emphasis is given to diets, diet preparation, and residues of pesticides or other contaminants in diets and fish.

75-000384 Chen, L.; Martinich, R. L. (Dep. Zool., San Diego State Univ., San Diego, CA 92182) PHEROMONAL STIMULATION AND METABOLITE INHIBITION OF OVULATION IN THE ZEBRAFISH, *BRACHYDANIO RERIO*. NOAA Fish. Bull. 73 (4): 889-894. Oct. 1975. SFA 20(4).

Female zebrafish, *Brachydanio rerio*, would not ovulate in the absence of males in waters previously inhabited by the fish. Chemical presence of males and fresh, dechlorinated tap water each induced ovulation in about half of the trials. Application of the two factors in combination gave 100 percent ovulation. These results suggest that in the zebrafish a pheromone released by the males stimulates ovulation and that metabolites produced by the fish repress ovulation. It is postulated that metabolites restrict spawning of the fish to the rainy season and that the pheromone functions in synchronizing reproductive readiness between sexes or in conserving courtship energy expenditure.

75-000385 Collins, M. T.; Gratzek, J. B.; Dawe, D. L.; Nemetz, T. G. (Dep. Med. Microbiol., Univ. Ga., Athens 30602) EFFECTS OF PARASITICIDES ON NITRIFICATION. J. Fish. Res. Board Can. 32 (11): 2033-2037. Nov. 1975. In English with French summ. SFA 20(4).

Treatment of four recirculating systems with a single dose of methylene blue at 5 mg/liter resulted in complete cessation of nitrification for 16 days as evidenced by a rapid rise in ammonia and stable nitrate concentrations. The therapeutic use of methylene blue in recirculating systems is contraindicated. Treatment of the systems with therapeutic levels of formalin, malachite green, formalin and malachite green in combination, copper sulfate, potassium permanganate, and sodium chloride had no effect on nitrification.

75-000386 Collins, M. T.; Gratzek, J. B.; Shotts, E. B., Jr.; Dawe, D. L.; Campbell, L. M.; Senn, D. R. (Dep. Med. Microbiol., Univ. Ga., Athens 30602) NITRIFICATION IN AN AQUATIC RECIRCULATING SYSTEM. J. Fish. Res. Board Can. 32 (11): 2025-2031. Oct. 1975. In English with French summ. SFA 20(4).

Water quality changes during establishment and maintenance of nitrification in four 70-liter recirculating systems each containing 20 channel catfish (*Ictalurus punctatus*) (total weight 150 g) are described. Establishment of nitrification took 33 days. During establishment of nitrification, all catfish in the systems died. Death appeared to be related to nitrite concentrations greater than 2.5 mg/liter NO(2)-N. The pH declined with progressive nitrification. When the pH was less than 6.0, nitrification ceased. Within 2 wk of introducing the catfish, total bacterial counts stabilized at 10⁶ organisms per milliliter. Counts of lactose fermenters and aeromonads fluctuated around 10⁴ organisms per milliliter when fish were in the system and decreased markedly after the fish were removed. After establishment of nitrification, 40 channel catfish (total weight 100 g) were maintained successfully for 37 days.

75-000387 Gary, D. L. (Dep. Earth Sci., Nicholls State Univ., Thibodaux, LA 70301) COMMERCIAL CRAYFISH POND MANAGEMENT IN LOUISIANA. Prog. Fish-Cult. 37 (3): 130-133. July 1975. SFA 20(4).

Due to negligent culture practices 40 percent of Louisiana's total managed pond area does not yield harvestable crayfish. Properly timed pond draining, flooding, stocking, and harvesting optimize crayfish reproduction, survival, and growth. Treeless ponds ideally yield at least 560 kg of live crayfish per ha per yr. The net income to the pond owner, assuming a fair market price, is about \$280/ha.

75-000388 Leon, K. A. (U.S. FWS, Tunison Lab. Fish Nutr., Cortland, NY 13045) IMPROVED GROWTH AND SURVIVAL OF JUVENILE ATLANTIC SALMON (*SALMO SALAR* L.) HATCHED IN DRUMS PACKED WITH A LABYRINTHINE PLASTIC SUBSTRATE. Prog. Fish-Cult. 37 (3): 159-163. July 1975. SFA 20(4).

To evaluate a hatchery rearing technique for Atlantic salmon (*Salmo salar* L.), I compared growth, survival, yolk sac absorption, and behavior of fish hatched and reared in drums with and without a labyrinthine plastic substrate. Fry reared with the substrate were about 45 percent heavier at first feeding, swam toward the surface earlier, and absorbed their yolk sacs faster than fry reared without the substrate. A high incidence of abnormal yolk sac absorption, as manifested by severely constricted yolk sacs, occurred only in fry reared without the plastic substrate. During the 126 days of observation, beginning at the critical initial feeding stage, about 94 percent of the fry reared with the plastic substrate survived, as compared with 81 percent of those reared without the substrate.

75-000389 Petrie, C. J.; Ehlinger, N. F. (N.Y. State Dep. Environ. Conserv., Fish Pathol. Lab., Rome 13440) A CONVENIENT METHOD OF MEDICATING DRY DIETS. Prog. Fish-Cult. 37 (4): 236. Oct. 1975. SFA 20(4).

The use of corn oil as a vehicle to convey medication to dry diets is described. (RS)

75-000390 Prentice, E. F. (NMFS, Northwest Fish. Cent., Seattle, WA 98112) AUTOMATIC FEEDING SYSTEM USING LIVE ARTEMIA. Prog. Fish-Cult. 37 (3): 168-169. July 1975. SFA 20(4).

75-000391 Rothbard, S. CONTROL OF /EUPLOTES/ SP. BY FORMALIN IN GROWTH TANKS OF /CHLORELLA/ SP. USED AS GROWTH MEDIUM FOR THE ROTIFER /BRACHIONUS PLICATILIS/ WHICH SERVES AS FEED FOR HATCHLINGS. Bamidgeh 27 (4): 100-109. Dec. 1975. SFA 20(4).

/Brachionus plicatilis/ is one of the important organisms which serves as natural food for sea fish larvae from artificial spawnings during their first days of nutrition. The rotifer plays an important role in forced growth of sea fish in Japanese hatcheries. Chlorella is used as growth medium for /Brachionus/ (in Japan this medium is popularly called "Green Water").

/Euplotes/, a protozoan of the ciliate group, readily feeds on chlorella and is one of the main factors inhibiting the growth of Chlorella medium and thus interferes with the normal development of /Brachionus/.

In the present work, the use of formalin as a means of eradicating /Euplotes/ without endangering /Chlorella/ or /Brachionus/ has been tested. It is shown that 1 day after the addition of 20-30 ppm formalin to /Chlorella/ medium, it may be used for the growth of /Brachionus/ and is not harmful in their development. Also this concentration destroys almost the entire /Euplotes/ population present in the medium.

75-000392 Webster, D. A. (Dep. Nat. Resour., Cornell Univ., Itaca, NY 14850) AN INEXPENSIVE MULTIPURPOSE CHANNEL FOR USE IN FISHERY RESEARCH AND MANAGEMENT. Prog. Fish-Cult. 37 (4): 224-226. Oct. 1975. SFA 20(4).

A simple, artificially controlled flow stream channel is described that is suitable for holding, observing, or rearing fish for short-term studies or activities. The prototype was of maze design and constructed of cement blocks laid up dry and lined with 20-gauge vinyl. In two seasons it has functioned well for incubation of smelt (/Osmerus mordax/) eggs, natural spawning of white suckers (/Catostomus commersoni utawana/) and brook trout (/Salvelinus fontinalis/), as well as for holding wild brood stocks of the latter species and for seasonal rearing of salmonid fingerlings.

GENERAL LIMNOLOGY AND OCEANOGRAPHY

75-000393 Fish, G. R. (Fish. Res. Div., Minist. Agric. Fish., Rotorua, New Zealand) LAKES ROTORUA AND ROTOITI, NORTH ISLAND, NEW ZEALAND: THEIR TROPHIC STATUS AND STUDIES FOR A NUTRIENT BUDGET. N. Z. Minist. Agric. Fish., Fish. Res. Bull. No. 8. 72p. 1975. SFA 20(4).

This survey shows that the condition of Lake Rotorua is changing, but that of Lake Rotoiti is much more stable. To some extent this situation is due to the physical differences between the two lake

75-000393 CONTINUED

basins; Lake Rotorua is shallow and generally well mixed by the wind and has a smaller water volume than Lake Rotiti, which is a typical monomictic lake. But many aspects of the limnology of the two lakes are related to their trophic states.

The eutrophic nature of Lake Rotorua is undoubtedly caused by the supply of fertilising substances to the basin from the drainage flows of the land catchment. These flows are small in relation to the size of the lake, the daily increment being only 0.2 percent of the lake volume, but it is probably significant that Lake Rotoiti is much less fertile and its daily increment from land drainage is five times less than that of Lake Rotorua. The inflow of plant nutrients into Lake Rotorua is much greater than their loss through the lake outlets via the Ohau Channel and the Kaituna River. Therefore plant nutrients may be accumulating in the lakes and promoting an increasingly vigorous biological cycle there. (From Auth. Summ.)

75-000394 Intergovernmental Oceanographic Commission (Unesco, 7, Place de Fontenoy, 75700 Paris, France) THE INTERNATIONAL DECADE OF OCEAN EXPLORATION (IDOE) 1971-1980. Intergov. Oceanogr. Comm. Tech. Ser. 13. 87p. 1975. SFA 20(4).

In accordance with the decision of the Assembly of the Intergovernmental Oceanographic Commission at its eighth session, November 1973 (resolution VIII-1, see Annex I), this document:

(a) sets forth the basis of LEPOR, of IDOE and of the Commission's Co-operative Investigations, and the criteria for inclusion of programmes therein;

(b) explains the arrangements for certification and for the deposition and exchange of data and reports resulting from the projects;

(c) gives the latest available information on the current status of the component programmes of LEPOR, of the IDOE and of the Commission's Co-operative Investigations.

The document will be updated periodically. (From Auth. Preface)

75-000395 Johnson, L. (Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB R3T 2N6, Canada) PHYSICAL AND CHEMICAL CHARACTERISTICS OF GREAT BEAR LAKE, NORTHWEST TERRITORIES. J. Fish. Res. Board Can. 32 (11): 1971-1987. Nov. 1975. In English with French summ. SFA 20(4).

Great Bear Lake is geologically very young, having been derived from Glacial Lake McConnell 8,000-10,000 yr BP. The lake is made up of two basins with a total volume of 2235.7 km³. This large volume of water and the northern continental climate of the region give rise to a lake that is essentially polar (cold monomictic) although in a northern temperature setting.

Chemical composition was extremely uniform; the only observable differences were local and associated with inflowing rivers. In dissolved solids content Great Bear Lake is close to the world's average for fresh water; it is not typical of waters of the Canadian Shield. Dissolved oxygen was high at all times; it reached a maximum level under the ice in April. The deep water remained fully saturated throughout the year.

Comparisons with truly arctic lakes show that Great Bear Lake is similar in many respects but in some aspects it is even more extreme. Although similar in size to Great Slave Lake, it is much more oligotrophic.

75-000396 Parsons, T. R. (Inst. Oceanogr., Univ. British Columbia, Vancouver, BC V6T 1W5, Canada) BIOLOGICAL OCEANOGRAPHY IN CANADA: A PERSPECTIVE AND REVIEW. J. Fish. Res. Board Can. 32 (11): 2231-2283. Nov. 1975. In English with French summ. SFA 20(4).

The history of biological oceanography is reviewed with respect to developments both in Canada and other lands. From this history it is suggested that biological oceanography should be broadly defined as a study of the biology of the oceans. Narrower fields of specialization, such as planktonology, fisheries ecology, or studies on the benthic habitat, should be integrated to provide a better biological basis for understanding ocean communities.

The interaction between biological oceanography and other studies in marine science is reviewed with respect to physical and chemical oceanography, fisheries, and pollution. Specific recommendations with respect to the future development of biological oceanography in Canada are made in the areas of national programs, training, instrument development, international relations, and interactions with other sciences in relation to the solution of practical problems in the marine environment.

75-000397 Pickard, G. L. (Inst. Oceanogr., Univ. British Columbia, Vancouver, BC V6T 1W5, Canada) ANNUAL AND LONGER TERM VARIATIONS OF DEEPWATER PROPERTIES IN THE COASTAL WATERS OF SOUTHERN BRITISH COLUMBIA. J. Fish. Res. Board Can. 32 (9): 1561-1587. Sept. 1975. In English with French summ. SFA 20(4).

Observations of deepwater properties (temperature, salinity, dissolved oxygen, and the derived values of density) have been assembled from the Data Reports of the Institute of Oceanography of the University of British Columbia and values of the first three properties are presented to show the characteristics of their annual variations at 18 locations in the coastal waters of southern British Columbia. Information on the long-term variations (for 6 yr or more) of all properties is presented for eight of the locations. Variations of 1-yr period are evident to 100 m depth at all locations and to 300 m or more at many of them. The variations are of different forms, sinusoidal, peaked or saw-tooth, and there are some differences in phase between the property variations at different locations. Long-term variations (over several years) of annual mean values are small and decrease with increase of depth. Much of the evidence suggests that the changes below 100 m depth are due to longitudinal advection (flow) from elsewhere rather than to vertical transfers from the sea surface in the immediate locality.

75-000398 Selgeby, J. H.; Jones, W. E. (U.S. FWS, Ashland Biol. Stn., Ashland, WI 54806) PHYSICAL AND CHEMICAL CHARACTERISTICS OF LAKE OAHE, 1968-69. U.S. Fish Wildl. Serv. Tech. Pap. 72. 18p. 1974. SFA 20(4).

The physical and chemical characteristics presented provide a description of Lake Oahe and establish bases for certain characteristics which may alter as the reservoir ages. Water temperatures were strongly influenced by wind-driven currents and water depth. The duration of thermal stratification varied from about 3 wk in the upstream portion of the reservoir to about 15 wk near the dam in 1968 and from unstratified upstream to about 15 wk downstream in 1969. Dissolved oxygen was usually near saturation, although it fell to 30 percent in 1968 and 43 percent in 1969. Nitrate nitrogen and soluble phosphorous were present on all sampling dates in 1969. Silica levels may have become limiting for diatoms in late summer, 1969.

75-000399 Therriault, J. C.; Lacroix, G. (Dep. Biol., Dalhousie Univ., Halifax, NS, Canada) PENETRATION OF THE DEEP LAYER OF THE SAGUENAY FJORD BY SURFACE WATERS OF THE ST. LAWRENCE ESTUARY. J. Fish. Res. Board Can. 32 (12): 2373-2377. Dec. 1975. In English with French summ. SFA 20(4).

A strong similarity is demonstrated in summertime physiochemical characteristics between the deep water of the Saguenay fjord and the surface water of the St. Lawrence estuary. Summer warming of the deep layer of the Saguenay is progressive from the mouth towards the head of the fjord. The mechanism proposed is the penetration of surface estuarine water over shallow sill during the rising tide. The abnormally high chlorophyll values in this deep layer may be explained by the same advective mechanism.

PHYSICAL LIMNOLOGY AND OCEANOGRAPHY

75-000400 Bakun, A. (NMFS, Monterey, CA 93940) DAILY AND WEEKLY UPWELLING INDICES, WEST COAST OF NORTH AMERICA, 1967-73. NOAA Tech. Rep. NMFS SSRF-693. iii + 114p. Aug. 1975. SFA 20(4).

Daily and weekly indices of intensity of large-scale wind-induced coastal upwelling at selected locations along the west coast of North America are presented for the 7-yr period, 1967-73. The indices are based on 6-hourly computations of the offshore component of Ekman transport using the synoptic surface atmospheric pressure analyses produced by the Fleet Numerical Weather Central to estimate the sea surface stress. The magnitude of offshore transport is considered an indication of resultant upwelling through the bottom of the Ekman layer. A spatial distortion in absolute magnitude results in noncomparability of numerical values between different locations.

75-000401 Husby, D. M.; Seckel, G. R. (NMFS, Monterey, CA 93940) LARGE-SCALE AIR-SEA INTERACTIONS AT OCEAN WEATHER STATION V, 1951-71. NOAA Tech. Rep. NMFS SSRF-696. iv + 44p. Nov. 1975. SFA 20(4).

The meteorological observations at OWS-V (Ocean Weather Station V, lat. 34°N, long. 164°E) were used to compute large-scale air-sea heat exchange processes and wind stresses for each month from September 1951 to March 1971. The monthly values are tabulated as anomalies from the 1955 to 1971 means. The quality of the data record and the accuracy of the derived heat exchange components are discussed.

The air-sea interaction climatology at OWS-V, which lies in the net annual heat loss area of the western North Pacific, is described. At this station the average monthly heat exchange across the sea surface is estimated to range from a gain during July of 307 cal/cm²/day to a loss during December of 388 cal/cm²/day with an annual loss of 32 cal/cm²/day. The principal process causing monthly and seasonal variations in the net heat exchange across the sea surface, besides the radiation from sun and sky, is the heat used for evaporation. The average monthly heat lost through evaporation is estimated to range from 86 cal/cm²/day during July to 374 cal/cm²/day during December with an annual average of 234 cal/cm²/day. Anomalous evaporation rates are caused by anomalous "vapor pressure differences" (saturation vapor pressure at the sea-surface temperature minus the vapor pressure of air) and/or anomalous wind speeds.

75-000402 Lafond, C. A.; Pickard, G. L. (Inst. Oceanogr., Univ. British Columbia, Vancouver, BC V6T 1W5, Canada) DEEPWATER EXCHANGES IN BUTE INLET, BRITISH COLUMBIA. J. Fish. Res. Board Can. 32 (11): 2075-2089. Nov. 1975. In English with French summ. SFA 20(4).

Bute Inlet is a fjord of the British Columbia mainland coast connected to the Strait of Georgia through Sutil Channel. The properties of the waters in the inlet were observed during a series of cruises from June 1972 to June 1974 with the main objective of determining the water exchange below the top 100 m.

Vertical longitudinal sections and time-series plots of salinity, temperature, and dissolved oxygen distributions measured during the 2-yr survey were used to analyze the circulation patterns and renewal processes of the water below 100 m.

Inflows of deep water from the Strait of Georgia into Bute occurred frequently during the study period, and took place when the water from the Strait of Georgia above the inlet sill depth was denser than the water in the basin of the inlet. Volumes of some inflows into Bute were estimated, and calculations indicate that inflow speeds could be large enough to be recorded by existing current meters. The renewal of the deep water in Bute Inlet basin appears to be basically consistent with the annual cycle of deepwater replacement in the Strait of Georgia with its year-to-year variations.

CHEMICAL LIMNOLOGY AND OCEANOGRAPHY

75-000403 Murphy, T. J.; Doskey, P. V. (DePaul Univ., Chicago, IL 60614) INPUTS OF PHOSPHORUS FROM PRECIPITATION TO LAKE MICHIGAN. U.S. Environ. Prot. Agency, Ecol. Res. Ser. EPA-600/3-75-005. viii + 27p. Dec. 1975. SFA 20(4).

Precipitation samples were collected at six locations around Lake Michigan and analyzed for the different forms of phosphorus present. It was found that the atmosphere is presently contributing one million kilograms per year of phosphorus or about 18 percent of the phosphorus budget of the Lake. As the phosphorus removal program on sewage effluents becomes fully implemented in the Lake Michigan basin, the contribution to the Lake of phosphorus from particulate matter scavenged by precipitation could increase to about 30 percent of the total.

The phosphorus concentration of precipitation was found to be higher at the southern end of the Lake. More than 40 percent of the phosphorus in precipitation is dissolved reactive phosphates and the amount of the dissolved reactive phosphates in precipitation was found to be somewhat dependent on the pH of the sample.

The washout ratio for phosphorus by precipitation was determined. It was also found from the analysis of some glacial samples that phosphorus has long been a component of precipitation.

75-000404 Ramamoorthy, S.; Kushner, D. J. (Dep. Biol., Univ. Ottawa, Ottawa, ON K1N 6N5, Canada) HEAVY METAL BINDING COMPONENTS OF RIVER WATER. J. Fish. Res. Board Can. 32 (10): 1755-1766. Oct. 1975. In English with French summ. SFA 20(4).

Ion-specific electrodes were used to measure the heavy metal (HM) binding capacity of river waters near Ottawa. Binding capacity was measured in unfiltered water and in water passed through filters retaining particles (0.45 μ m) and macromolecules of molecular weight (MW) 45,000, 16,000 and 1,400. In the most studied water samples, almost all the Hg⁺⁺-binding ability passed through the smallest filter. Filters of different pore sizes retained substantial fractions of the binding ability towards other HM ions. Binding strengths and

75-000404 CONTINUED

conditional binding constants were calculated for each HM ion and low MW Ottawa River water components.

Binding in Ottawa River water was not due to HCO_3^- or CO_3^{2-} ions; in the Rideau Canal, and probably in other bodies of water, such ions caused a substantial amount of binding. After complete ashing of Ottawa River water and reconstitution with deionized water almost all the HM binding ability was lost; thus, an organic compound(s) is responsible for binding.

The binding pattern towards different HM ions of fulvic acid isolated from soil was different from that of unfiltered or filtered Ottawa River water. Fulvic acid is not the sole binding component of this water. These experiments suggest a way of assessing the importance of fulvic acid and other humic substances in HM binding by natural waters.

BENTHOS

75-000405 Dadswell, M. J. (Dep. Biol., Carleton Univ., Ottawa, ON, Canada) A SMALL-BOAT OTTER TRAWL FOR LIMNOLOGICAL STUDIES. J. Fish. Res. Board Can. 32 (12): 2535-2538. Dec. 1975. In English with French summ. SFA 20 (4).

A small otter trawl, 2.5 m wide by 5.5 m long, is described and a method for its use by two operators from a small boat (3-5 m long) powered by an outboard motor is discussed. This small trawl proved efficient in the rapid collection of large numbers of benthic and epibenthic organisms in lakes at depths between 5 and 100 m.

75-000406 Flint, R. W. (State Univ. Coll. Buffalo, Buffalo, NY 14222) GROWTH IN A POPULATION OF THE CRAYFISH /PACIFASTACUS LENIUSCULUS/ FROM A SUBALPINE LACUSTRINE ENVIRONMENT. J. Fish. Res. Board Can. 32 (12): 2433-2440. Dec. 1975. In English with French summ. SFA 20 (4).

Observations on growth increments at each molt in a population of /Pacifastacus leniusculus/ from a subalpine lake were made from periodically recaptured marked crayfish, as well as from molts recorded in the laboratory. After the first growing season the growth increment at molt remained relatively constant. Throughout the life of this crustacean no differences were observed between sexes. Analysis of size distributions in samples taken at different times of the year revealed that between 8 and 12 year-classes were normally present in the population of Lake Tahoe. Growth of these age-classes could be followed through consecutive samples. The number of molts completed by each year-class was found by relating data on growth increment per molt to growth shown in consecutive quantitative samples. Mean carapace length at recruitment for juvenile crayfish was 3.75 mm with 11 molts occurring during the first growing season, and juveniles reached 13.0 mm by the end of their first year. Molt frequency decreased in successive year-classes, and crayfish surviving past their fourth growth season molted only once a year. Length-weight relationships were similar for both sexes of the population even though their external anatomy differed. Growth comparison between this population and that of a coastal stream population showed that the stream population had a slightly faster overall growth rate due to higher water temperatures and a longer growing season.

75-000407 Fox, R. S.; Bynum, K. H. (Dep. Zool., Univ. N.C., Chapel Hill 27514) THE AMPHIPOD CRUSTACEANS OF NORTH CAROLINA ESTUARINE WATERS. Chesapeake Sci. 16 (4): 223-237. Dec. 1975. SFA 20(4).

Seventy-four species of gammaridean (nine undescribed) and four species of caprellidean amphipods are reported from estuarine waters of North Carolina. The range of *Grandidierella bonnieroides* is extended northward and that of *Ampithoe valida*, *Argissa hamatipes* and *Corophium insidiosum* is extended southward. Notes on habitats and zoogeography are included, as well as a key to identification. Most species occurring in North Carolina belong to an assemblage ranging from Cape Cod to northeastern Florida. Cape Hatteras does represent a significant faunistic boundary to estuarine amphipod species.

75-000408 Jones, W. E.; Selgeby, J. H. (U.S. FWS, Billings, MT 59102) INVERTEBRATE MACROBENTHOS OF LAKE OAHE, 1968-69. U.S. Fish Wildl. Serv. Tech. Pap. 73. 11p. 1974. SFA 20(4).

The benthos in Lake Oahe, as determined from about 450 bottom samples collected during the open water season in 1968 and 1969, was dominated by oligochaetes and chironomids; *Caenis* (Ephemeroptera) and *Chaoborus* (Diptera) were occasionally abundant. Total benthos was estimated at 3,600 organisms/m² with an ash-free dry weight of about 2.2 g/m² (about 33 kg/hectare dry weight). Estimated biomass was 1.3 g/m² (about 18.5 kg/hectare dry weight) at depths of 0.5-10 m and 3.5 g/m² (about 52.5 kg/hectare dry weight) at greater depths.

75-000409 Klattenberg, R. P. (QLM Lab., Inc., Oswego, NY 13126) A PLEXIGLASS SUBSAMPLING BOX FOR LARGE BENTHOS SAMPLES. Prog. Fish-Cult. 37 (3): 165. July 1975. SFA 20(4).

75-000410 Mills, E. L. (Dep. Oceanogr., Dalhousie Univ., Halifax, NS B3H 3J5, Canada) BENTHIC ORGANISMS AND THE STRUCTURE OF MARINE ECOSYSTEMS. J. Fish. Res. Board Can. 32 (9): 1657-1663. Sept. 1975. In English with French summ. SFA 20(4).

The contribution of benthic ecology to biological oceanography has been relatively slight, even though the benthos may be crucial in understanding the dynamics of marine ecosystems, as J. H. Steele's model of the North Sea indicates. Before the benthos may be accurately assigned a role in such models, we need to know at least 1) what food items are consumed and assimilated, 2) what the role of bacteria and meiobenthos may be, and 3) if there are different levels of demersal fish production from differently structured benthic communities. There seem to be no shortcuts to the kind of information about benthic animals useful in permitting assessment of fisheries production in a realistic biological framework.

75-000411 Rowe, G. T.; Polloni, P. T.; Haedrich, R. L. (Woods Hole Oceanogr. Inst., Woods Hole, MA 02543) QUANTITATIVE BIOLOGICAL ASSESSMENT OF THE BENTHIC FAUNA IN DEEP BASINS OF THE GULF OF MAINE. J. Fish. Res. Board Can. 32 (10): 1805-1812. Oct. 1975. In English with French summ. SFA 20(4).

The abundance, biomass, and diversity of the macro- and mega-fauna in the deep basins of the Gulf of Maine were estimated from 41 quantitative infaunal samples and 19 visual transects made with the Deep Submergence Research Vessel (DSRV) *Alvin*. The homogeneous fine silt and clay (66 percent clay) sediments supported an infaunal abundance (mean = 4000 individuals/m²) and wet preserved biomass (mean = 27 g/m²) which were relatively low for a continental margin (270-297 m deep) with a high sediment organic carbon (1.9 percent). Diversity

75-000411 CONTINUED

estimates ($H[s]$) from /Alvin/ box core samples were lower than /Alvin/ box core sample values from the continental slope, suggesting that the seasonally stable Gulf of Maine basins, because of their short geologic age, do not yet contain an equilibrium assemblage. An additional possibility is that seasonal variations in the production of organic matter, being more pronounced in the Gulf of Maine than offshore in deep water, affect community structure on the bottom.

75-000412 Saether, O. A. (Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB, Canada) NEARCTIC AND PALAEARCTIC /HETEROTRISSOCLADIUS/ (DIPTERA: CHIRONOMIDAE). Bull. Fish. Res. Board Can. 193. viii + 67p. 1975. In English with French summ. SFA 20 (4).

New descriptions, redescrptions, taxonomical and ecological comments, and distribution records are given for 15 species of /Heterotrissocladius/ Sparck. Four new species are described in all stages: /Heterotrissocladius oliveri/, /Heterotrissocladius latilaminus/, /Heterotrissocladius hirapex/, and /Heterotrissocladius changi/. The male of one new species, /Heterotrissocladius cooki/, is described. Two other species, /Heterotrissocladius grimshawi/ (Edw.) and /Heterotrissocladius scutellatus/ (Goetgh.), are redefined. Altogether eight species are completely described. Descriptions of the male, pupa, and larva of one species; the male of one species; the pupa and larva of two species; and the larva only of three species, are also provided.

Keys are given for male and female imagines, pupae, and larvae of the known Nearctic and Palaearctic species of the genus.

The phylogeny of the genus and of three related genera, /Paratrissocladius/ Zavz., /Parametriocnemus/ Goetgh., and /Paraphaenocladius/ Thien., is discussed. Sixty-one trends have been deduced and a kladogenetic diagram erected showing /Paratrissocladius/ as the sister group of /Heterotrissocladius/, and /Parametriocnemus/ plus /Paraphaenocladius/ as the sister group of the two first genera combined. /Heterotrissocladius/ can be divided into three species groups with the /subpilosus/ group being the sister group of the /maeeri/ and /marcidus/ group combined.

The ecology of the species is discussed pointing out their important position as members of ultraoligotrophic and/or moderately oligotrophic lakes.

75-000413 Smith, K. L., Jr.; Harbison, G. R.; Rowe, G. T.; Clifford, C. H. (Woods Hole Oceanogr. Inst., Woods Hole, MA 02543) RESPIRATION AND CHEMICAL COMPOSITION OF /PLEURONCODES PLANIPES/ (DECAPODA: GALATHEIDAE): ENERGETIC SIGNIFICANCE IN AN UPWELLING SYSTEM. J. Fish. Res. Board Can. 32 (9): 1607-1612. Sept. 1975. In English with French summ. SFA 20 (4).

The energetic importance of the galatheid crab, /Pleuroncodes planipes/, was examined in the California Current off Baja California during April 1973. Respiration of /Pleuroncodes/ ranged from 132 to 408 $\mu\text{l O}_2/\text{h}$, which was equivalent to 404-728 $\mu\text{l O}_2/\text{g}$ ash free dry wt/h. Analyses of /Pleuroncodes/ revealed that water, ash, protein, lipid, and chitin constituted 84, 7, 3.5, 0.7, and 2.8 percent of the total weight, respectively. These analyses give a mean caloric content of 1700 ± 430 cal. /Pleuroncodes/ is a dominant functional component of the upwelling ecosystem in the California current and is comparable to the anchovy, /Engraulis ringens/, in the Peru upwelling ecosystem.

75-000414 Stewart, K. W. (Dep. Biol. Sci., North Texas Univ., Denton 76203) AN IMPROVED ELUTRIATOR FOR SEPARATING STREAM INSECTS FROM STONY SUBSTRATES. Trans. Am. Fish. Soc. 104 (4): 821-823. Oct. 1975. SFA 20(4).

An improved "bubbling tube" elutriator apparatus for separating stream insects and other macroinvertebrates from stony substrates in described. In test runs the apparatus separated, by a float-over principle, 26 different taxa in 6-min operating time per sample. Almost 100 percent separation was achieved for dominant insects /Cheumatopsyche/ sp., /Hydropsyche simulans/, /Neochoroterpes mexicanus/, /Stenelmis/ sp., /Simulium/ sp., and Chironomidae. The device can also be used to successfully wash eggs of stoneflies and other aquatic insects from large volumes of sand-gravel substrates in a minimum amount of time.

PLANKTON

75-000415 Busdosh, M.; Atlas, R. M. (Dep. Biol., Univ. Louisville, Louisville, KY 40208) RESPONSE OF TWO ARCTIC AMPHIPODS, /GAMMARUS ZADDACHI/ AND /BOECKOSIMUS (ONISIMUS) AFFINIS/, TO VARIATIONS IN TEMPERATURE AND SALINITY. J. Fish. Res. Board Can. 32 (12): 2564-2568. Dec. 1975. In English with French summ. SFA 20(4).

Two arctic amphipods were found to be capable of tolerating a wide range of temperatures and salinities. They were tolerant to both abrupt changes, as would occur in crossing a thermocline, and to gradual changes, as would occur seasonally.

/Gammarus zaddachi/ could survive lower salinities and higher temperatures than /Boeckosimus (Onisimus) affinis/. Salinity had a statistically significant effect on rates of respiration for both organisms, but only /Gammarus zaddachi/ showed significant changes in respiration rate in response to temperature changes. The ecological distribution of these amphipods appears to be in part determined by their ability to tolerate fluctuations in salinity and temperature.

75-000416 de Bernardi, R. THE DYNAMICS OF A POPULATION OF /DAPHNIA HYALINA/ LEYDIG IN LAGO MAGGIORE, NORTHERN ITALY. Mem. Ist. Ital. Idrobiol. 31: 221-243. 1974. In English with Italian summ. SFA 20(4).

This paper discusses the dynamics of a population of /Daphnia hyalina/ in Lago Maggiore.

A simple mathematical model of compartmental analysis plus Edmondson's formulas based on the egg ratio, permitted the evaluation of the influences of various environmental factors on the development of the population. Predation operating on the sexually immature component of the population had a different effect on the population than that operating on sexually mature individuals.

The primary role of availability of food in controlling the development of the population is emphasized.

75-000417 Fagot, D. (Wis. Dep. Nat. Resour., Fish. Res. Stn., Madison 53711) SHALLOW-WATER ZOOPLANKTON SAMPLER. Prog. Fish-Cult. 37 (4): 201. Oct. 1975. SFA 20(4).

The zooplankton sampler consists of a Homelite (Model XLS 1-1/2-1A) gasoline-powered, 2-cycle pump connected to a Badger (Model 40) water meter which is calibrated in tenths of gallons. Water is drawn into the pump through a 9-ft hard rubber hose, into the meter and then into plankton net and cup. Cost of the sampler exclusive of the plankton net and cup is approximately \$338.00.

75-000418 Findlay, D. L.; Kling, H. J. (Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB, Canada) SEASONAL SUCCESSIONS OF PHYTOPLANKTON IN SEVEN LAKE BASINS IN THE EXPERIMENTAL LAKES AREA NORTHWESTERN ONTARIO FOLLOWING ARTIFICIAL EUTROPHICATION. Environ. Can. Fish. Mar. Serv. Tech. Rep. No. 513. ii + 53p. 1975. In English with French summ. SFA 20 (4).

This report summarizes the changes in the phytoplankton communities of seven lake basins following artificial enrichment with nitrate, phosphate and carbon. Data presented comes from studies of Lakes 227, 304, 226 (southeast and northwest basins), 261, and 302 (north and south basins) carried out from 1969 to 1973. A total of 280 taxa were identified and a table indicates where they were found and at what season of the year.

75-000419 Gale, W. F. (Ichthyol. Assoc., Inc., RD 1, Berwick, PA 18603) A QUICK-OPENING BUCKET FOR PLANKTON AND LARVAL FISH NETS. Prog. Fish-Cult. 37 (3): 164. July 1975. SFA 20 (4).

75-000420 Gopalakrishnan, K. (Hawaii Inst. Mar. Biol., P.O. Box 1346, Kaneohe 96744) BIOLOGY AND TAXONOMY OF THE GENUS *NEMATOSCELIS* (CRUSTACEA, EUPHAUSIACEA). NOAA Fish. Bull. 73 (4): 797-814. Oct. 1975. SFA 20 (4).

The seven species of *Nematoscelis*, *N. difficilis*, *N. megalops*, *N. gracilis*, *N. microps*, *N. tenella*, *N. atlantica*, and *N. lobata*, are described in a comparative manner, and keys for their identification are provided. The key to the larvae is based on structural differences in the carapace and rostrum of furcilia stages, whereas the key to adults is mostly based on diagnostic features of the first thoracic leg (maxilliped) and a male secondary sexual structure, the petasma. *Nematoscelis gracilis* is represented by two distinct forms; they are considered ecophenotypes, since their patterns of geographical distribution appear correlated with differences in environmental characteristics, particularly the distribution of dissolved oxygen in the water column. Diagnostic features of these forms are pointed out. The antennule and carapace are sexually dimorphic in adults of all *Nematoscelis*. Abdominal photophores in the males show species-specific patterns of enlargement.

75-000421 Maynard, S. D.; Riggs, F. V.; Walters, J. F. (Dep. Oceanogr., Univ. Hawaii, 2525 Correa Rd., Honolulu 96822) MESOPELAGIC MICRONEKTON IN HAWAIIAN WATERS: FAUNAL COMPOSITION, STANDING STOCK, AND DIEL VERTICAL MIGRATION. NOAA Fish. Bull. 73 (4): 726-736. Oct. 1975. SFA 20 (4).

On one cruise off leeward Oahu, Hawaii, micronekton from 9 deep-oblique mid-water trawl tows (0-1,200 m) and a 24-h series of 14 consecutive shallow-oblique tows (0-400 m) were sorted into 16 faunal groups, enumerated, and weighed. Diel-related trawl avoidance was not significant in deep tows. Mean total micronekton standing stocks for the deep tows were 898 organisms/00 m² ocean surface and 494 g (wet weight)/100 m² ocean surface. Fishes comprised half of the total numbers and biomass, while crustaceans contributed one-third of the total numbers and one-fifth of the biomass. Of the micronekton deeper than 400 m during the day, 43 percent of the number of organisms with 47 percent of the biomass migrated into the upper 400 m at night.

75-000422 Pejler, B. (Inst. Limnol., Univ. Uppsala, Sweden) ON LONG-TERM STABILITY OF ZOOPLANKTON COMPOSITION. Rep. Inst. Freshwater Res. Drottningholm No. 54: 107-117. 1975. SFA 20(4).

The main impression from the material here presented is, however, a high degree of similarity between older and newer samples. This demonstrates a remarkable stability of the zooplankton composition, in contradiction to the hypotheses sometimes put forward of plankton as an extraordinarily labile biocenose. The title of the present paper has been chosen precisely in order to stress this point. The changes actually found seem to be of a short-term rather than a long-term nature.

The only tendency that has been traced in connection with these comparisons is one towards increasing eutrophy. Though this tendency is not very strong, it should not be overlooked, since the first effect of an enrichment ought not to be a change in zooplankton composition but an increase in the individual number of all or most species (/cf./ Brooks 1969, p. 246 ff., and Dottne-Lindgren and Persson 1973, p. 10). However, the abundance cannot be discussed in this context, as quantitative data are often lacking, especially in the older investigations. (From Auth. Discuss.)

75-000423 Selgeby, J. H. (U.S. FWS, P.O. Box 48, Ashland, WI 54806) LIMNETIC CRUSTACEAN ZOOPLANKTON OF LAKE OAAHE, MAY-OCTOBER 1969. U.S. Fish Wildl. Serv. Tech. Pap. 74. 11p. 1974. SFA 20(4).

The limnetic crustacean zooplankton of Lake Oahe was dominated by copepods. /Cyclops bicuspidatus thomasi/ was the dominant crustacean throughout the lake. /Mesocyclops edax/, /Diaptomus ashlandi/, and /Daphnia pulex/ were major components of the zooplankton in the deep, downstream portion of the lake while /Bosmina longirostris/ and /Daphnia retrocurva/ were important constituents in the river-like, upstream section of the lake.

75-000424 Stockner, J. G.; Shortreed, K. R. S. (Fish. Mar. Serv., Pacific Environ. Inst., West Vancouver, BC V7V 1N6, Canada) PHYTOPLANKTON SUCCESSION AND PRIMARY PRODUCTION IN BABINE LAKE, BRITISH COLUMBIA. J. Fish. Res. Board Can. 32 (12): 2413-2427. Dec. 1975. In English with French summ. SFA 20(4).

Ten stations located in six zones (subbasins) were sampled biweekly from May to October 1973 to detect possible regional differences in production in this large, 155 km long, dystrophic lake. The spring bloom occurred in all zones while a fall bloom occurred only in Zones 5 and 6. Carbon assimilation showed two peaks in south basin zones, but only one (spring) at zones north of Topley Landing. Seasonal variation in phytoplankton numbers and volume, seston, and chlorophyll /a/ followed a pattern similar to that noted for primary production. Mean production was 100 mg C/m²/day in Zones 1-4, but was 145 in Zones 5 and 6. Annual production was estimated at 25 g C/m² in the northern basin and 40 in the south basin. Reasons for the regional disparities are discussed, with greatest significance given to regional variations in mixed layer depth, surface inflows (loading), and basin mean depth. The development and sustainment of the autumnal bloom of /Tabellaria fenestrata/ is thought to be one of the principal factors responsible for greater production in the south basin.

An estimated 0.05 g TP/m² enters the lake yearly. This can vary depending on the return of adult sockeye salmon (/Oncorhynchus nerka/), whose carcasses contribute up to 20 percent of the total. An estimated 30 percent is lost via the Babine River, and it is speculated that of the remaining 70 percent, most is lost to the sediments. Phosphate limitation is implied as a chief factor limiting primary production in the north basin stations, but not in the south basin. On the basis of total phosphorus load the lake is classed as

75-000424 CONTINUED

oligotrophic, but in terms of annual production and its humic stained waters it is more correctly considered mixotrophic.

75-000425 Takahashi, M.; Ikeda, T. (CEPEX Lab., P.O. Box 2085, Sidney, BC V8L 3S3, Canada) EXCRETION OF AMMONIA AND INORGANIC PHOSPHORUS BY /EUPHAUSIA PACIFICA/ AND /METRIDIA PACIFICA/ AT DIFFERENT CONCENTRATIONS OF PHYTOPLANKTON. J. Fish. Res. Board Can. 32 (11): 2189-2195. Nov. 1975. In English with French summ. SFA 20 (4).

Rates of excretion in the forms of ammonia and inorganic phosphorus were determined for /Euphausia pacifica/ and /Metridia pacifica/ at different phytoplankton concentrations. Nutrient uptake rate of the phytoplankton sample for each experiment was determined using Michealis-Menten kinetics. The gross excretion of nutrients by zooplankton ($E(g/l)$) was estimated by summing the apparent excretion ($E(a/l)$) and nutrient removed by phytoplankton ($E(u/l)$) as follows: $E(g/l) = E(a/l) + E(u/l)$.

Two significant effects of phytoplankton on zooplankton excretion were recognized: 1) rapid removal from the medium of nutrients excreted by zooplankton, and 2) increase in nutrient excretion of zooplankton. Phytoplankton could remove 0-100 percent of the nutrients excreted by zooplankton. The increase in nutrient excretion by zooplankton due to adding phytoplankton was proportional to the amount of phytoplankton ingested. Compared with the excretion rate at zero phytoplankton density, the estimated increase in excretion rate was as high as 5 times at 15 ug chlorophyll a/l (optimum phytoplankton density) for /M. pacifica/ and almost 9 times at 70 ug chlorophyll a/l for /E. pacifica/.

75-000426 Wiebe, P. H.; Boyd, S.; Cox, J. L. (Woods Hole Oceanogr. Inst., Woods Hole, MA 02747) RELATIONSHIPS BETWEEN ZOOPLANKTON DISPLACEMENT VOLUME, WET WEIGHT, DRY WEIGHT, AND CARBON. NOAA Fish. Bull. 73 (4): 777-786. Oct. 1975. SFA 20 (4).

Interconversion of various measures of zooplankton biomass have great utility in studies requiring nondestructive techniques, or for interpretation of past data. In establishing predictive relationships between such measures, the appropriate regression to use is the geometric mean estimate, which provides a regression line in which the regressions of X on Y and Y on X are identical. We have employed this type of analysis in determinations on samples from diverse sea areas in different seasons and have determined that statistically significant relationships exist between carbon, wet weight, displacement volume, and dry weight when a constant technique is used. The slope of the regression line for log transformed values for carbon vs. dry weight and wet weight vs. displacement volume was sufficiently close to unity to assume a straight percentage conversion between these values. Carbon was 31-33 percent of dry weight and wet weight was 72-73 percent of displacement volume, according to our techniques. Comparability of different techniques for a biomass measurement may be poor, especially in the case of displacement volume and wet weight measurements due to variations in the interstitial water content. Moreover, interstitial water content varies inversely with total biomass density, which accounts for the absence of a simple percentage relationship between wet weight or displacement volume and other measures of zooplankton biomass.

PRIMARY PRODUCTION

75-000427 Shearer, J. A.; Fee, E. J. (Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB, Canada) PHYTOPLANKTON PRIMARY PRODUCTION IN THE EXPERIMENTAL LAKES AREA USING AN INCUBATOR TECHNIQUE-1973 DATA. Environ. Can. Fish. Mar. Serv. Tech. Rep. No. 474. iii + 110p. 1974. In English with French summ. SFA 20(4).

This report summarizes phytoplankton photosynthesis in data obtained on 8 lake basins in the Experimental Lakes Area during 1973. Details of field and laboratory techniques are given and the data are presented both tabularly and graphically.

MORPHOLOGY

75-000428 Lindsey, C. C. (Dep. Zool., Univ. Manitoba, Winnipeg, MB R3T 2N2, Canada) PLEOMERISM, THE WIDESPREAD TENDENCY AMONG RELATED FISH SPECIES FOR VERTEBRAL NUMBER TO BE CORRELATED WITH MAXIMUM BODY LENGTH. J. Fish. Res. Board Can. 32 (12): 2453-2469. Dec. 1975. In English with French summ. SFA 20(4).

Data for 3137 fish species were analyzed for possible correlations, among related species, between vertebral number (V) and maximum recorded body length (L). Of 118 families having counts for over 4 species, 90 show a positive correlation; statistically significant correlations are positive in 45 and negative in only 2 families. The relationship can be expressed by the power function $V = CL$ to the $/m/$, in which C and $/m/$ are constants characteristic of each family or taxon. Among families with a significant correlation between V and L, the median value of $/m/$ is 0.12 (representing about 10 percent vertebral increase for each doubling of length) but $/m/$ ranges widely, from -0.033 to +0.416. Families with high mean vertebral counts tend to have high $/m/$ values. The phenomenon, termed pleomerism, occurs within genera as well as within families, and sometimes between races, between populations, or even between the sexes. It exists in widely different shapes of fishes (e.g. sharks, mackerels, sea horses, sand lances, and lumpfish) and in caecilians and in sea snakes. Latitudinal gradients in vertebral number (Jordan's rule) are often reinforced by pleomerism coupled with latitudinal gradients in maximum length, but gradients in vertebral numbers persist even when effect of maximum length is removed. Although its cause is unknown, pleomerism is taxonomically useful in predicting adult sizes of species known only from young specimens, and in unmasking synonymies of "species" based on young of other named species. Vertebral number considered in conjunction with maximum size is more reliable for making taxonomic judgements at all levels than is vertebral number alone. Moreover, if the cause of pleomerism is functional, it may provide information on locomotory mechanisms and on population biology, since mean vertebral number in each population may be matched to that body size at which selection operates most significantly.

75-000429 Rannou, M.; Thiriot-Quievreux, C. (Lab. Hydrobiol., Univ. Sci. Tech. Lang., place Eugene-Bataillon, F 34060, Montpellier Cedex, France) STRUCTURE DES OTOLITHES D'UN /MACROURIDAE/ (POISSON GADIFORME) BATHYAL. ETUDE AU MICROSCOPE ELECTRONIQUE A BALAYAGE. [STRUCTURE OF OTOLITHS OF A DEEP-SEA MACROURID (PISCES GADIFORMES). A SCANNING ELECTRON MICROSCOPE STUDY.] Ann. Inst. Oceanogr. 51 (2): 195-201. 1975. In French with English summ. SFA 20(4).

The structure of the otoliths of the deep-sea Macrourid /Coryphaenoides guentheri/ was determined by means of scanning electron microscopy. The structure of the concentric zones is the same as in otoliths of fish from upper layers and cyclic phenomena exist for deep-sea fish as well.

75-000430 Spratt, J. D. (Calif. Dep. Fish Game, Sacramento 95814) ANOMALOUS OTOLITHS FROM THE NORTHERN ANCHOVY, /ENGRAULIS MORDAX/. Calif. Fish Game 61 (4): 235-236. Oct. 1975. SFA 20(4).

PHYSIOLOGY

75-000431 Ackman, R. G.; Eaton, C. A.; Linke, B. A. (P.O. Box 429, Halifax, NS B3J 2R3, Canada) DIFFERENTIATION OF FRESHWATER CHARACTERISTICS OF FATTY ACIDS IN MARINE SPECIMENS OF THE ATLANTIC STURGEON, /ACIPENSER OXYRHYNCHUS/. NOAA Fish. Bull. 73 (4): 838-845. Oct. 1975. SFA 20(4).

Lipids and fatty acids of two marine-caught specimens of the Atlantic sturgeon, /Acipenser oxyrhynchus/, which spawns and also feeds in freshwater, were examined. Specific fat contents, respectively 47.2 and 25.0 percent in orange-colored dorsal tissue and 8.5 percent in both livers, were high but not unexpected for sturgeons generally. In each fish a very consistent basic fatty acid composition of depot fats showed that this fat in various parts of the body had a common function. Depot fat from the fatter fish had high iodine values (ca. 190) while in the leaner fish values were lower (ca. 135) and more typical of sturgeons generally. The fatty acid details of depot fats showed some characteristics of marine fats, such as the presence of the unusual omega 1 and omega 4 polyunsaturated fatty acids, the low figure for linoleic acid and relatively high proportions of long chain polyunsaturated fatty acids, but were more typical of freshwater fats in the virtual absence of eicosenoic and docosenoic acids. Broadly speaking, the fatty acids of the Atlantic sturgeon seem to place it in a special class of fish with fats generally resembling freshwater fish fats in composition, despite its marine origin.

75-000432 Atchison, G. J. (Bionucleon. Dep., Purdue Univ., West Lafayette, IN 47907) FATTY ACID LEVELS IN DEVELOPING BROOK TROUT (/SALVELINUS FONTINALIS/) EGGS AND FRY. J. Fish. Res. Board Can. 32 (12): 2513-2515. Dec. 1975. In English with French summ. SFA 20(4).

Changes in the fatty acid composition of the yolk and fry of developing brook trout (/Salvelinus fontinalis/) were analyzed. Palmitic (16:0) and docosahexaenoic (22:6) acids were characteristic of the fry and oleic (18:1) and linoleic (18:2) acids were selectively retained in the yolk.

75-000433 Balon, E. K. (Dep. Zool, Univ. Guelph, Guelph, ON N1G 2W1, Canada) TERMINOLOGY OF INTERVALS IN FISH DEVELOPMENT. J. Fish. Res. Board Can. 32 (9): 1663-1670. Sept. 1975. In English with French summ. SFA 20(4).

The intervals in fish ontogeny are once more defined and standard names proposed for each. Names such as fry, prelarva, postembryonic stage, free-swimming stage, etc. are discouraged and specific terms -- cleavage egg, embryo, eleutheroembryo, protopterygiolarva, and pterygiolarva or alevin, juvenile, adult, and senescent fish -- are suggested instead.

75-000434 Bieniarz, K.; Opuszyński, K. DOJRZEWANIE PLCIOWE RYB (SYNTEZA LITERATURY SWIATOWEJ). [SEXUAL MATURATION IN FISH (REVIEW OF WORLD LITERATURE)] Rocz. Nauk Roln. Ser. H Rybactwo 96 (3): 7-26. 1974. In Polish with English summ. SFA 20(4).

The course of sexual maturation in /Teleostei/ as the result of interaction of brain, pituitary gland and gonads. Differences with this regard between the /Teleostei/ and the remaining vertebrates. The effect of some external factors upon the maturation of fish. (Auth. Synopsis)

75-000435 Borjeson, H.; Hoglund, L. B. (Inst. Zoophysiol., Univ. Uppsala, Sweden) MUSCLE AND BLOOD LACTATE IN JUVENILE /SALMO SALAR/ EXPOSED TO HIGH PCO(2). Rep. Inst. Freshwater Res. Drottningholm No. 54: 5-7. 1975. SFA 20(4).

The lactate content in the body muscle of salmon parr (/Salmo salar/ L.) increases during the initial phase of hyperactivity and acidosis due to hypercapnia deriving from a sudden rise of the PCO(2) in the respiratory water. This is not accompanied by any statistically significant elevation of the blood lactate level. The biological significance of this event is briefly discussed. (Auth. Summ.)

75-000436 Braekevelt, C. R. (Univ. Manitoba, Winnipeg, MB R3E 0W3, Canada) PHOTORECEPTOR FINE STRUCTURE IN THE NORTHERN PIKE (/ESOX LUCIUS/). J. Fish. Res. Board Can. 32 (10): 1711-1721. Oct. 1975. In English with French summ. SFA 20(4).

The morphology of the retinal photoreceptors has been studied in the adult northern pike (/Esox lucius/) by light and electron microscopy. Three photoreceptor types are seen: rods, single cones, and twin cones. The rod photoreceptors are the most numerous. They are elongate cells basically similar to other vertebrate rod cells described. Twin cones are the more numerous of the two cone types present and are formed by two cone cells lying in close apposition along their inner segments, with a membrane specialization where the two cells are apposed. Each member of the twin cone is morphologically similar to the other and to the single cone. The cone photoreceptors display in addition to the regular outer segment, an accessory outer segment. The ellipsoid of the cone cell inner segment is unusually large. The synaptic region of the cone cells is larger and more elaborate than that of the rods. Synapses in both rods and cones, however, appear to be formed by both superficial and invaginated contacts with bipolar and horizontal cells. The single and double cones are arranged in a well-defined, repeating mosaic pattern.

75-000437 Brauhn, J. L.; McCraren, J. (U.S. FWS, Fish Genetics Lab., Beulah, WY 82712) OVARY MATURATION IN CHANNEL CATFISH. Prog. Fish-Cult. 37 (4): 209-212. Oct. 1975. SFA 20 (4).

Ovary maturation in channel catfish (*Ictalurus punctatus*) maintained in hatchery ponds under variable light and temperature is compared with that in brood stock held under controlled conditions. The condition of the ovaries is described at three periods in the cycle: immediately after spawning, mid-winter, and immediately before spawning. The influence of lowered water temperature and reduced light slowed ovary maturation.

75-000438 Brett, J. B.; Zala, C. A. (Fish. Mar. Serv., Pacific Biol. Stn., Nanaimo, BC V9R 5K6, Canada) DAILY PATTERN OF NITROGEN EXCRETION AND OXYGEN CONSUMPTION OF SOCKEYE SALMON (*ONCORHYNCHUS NERKA*) UNDER CONTROLLED CONDITIONS. J. Fish. Res. Board Can. 32 (12): 2479-2486. Dec. 1975. In English with French summ. SFA 20 (4).

Measurements of the rate of ammonia and urea excretion of fingerling sockeye salmon (*Oncorhynchus nerka*) in fresh water were made at 2-3-hourly intervals throughout the day (average weight = 29 g; temperature = 15 C). One group of fish was fed a maintenance ration while another group was starved for 22 days. Ammonia excretion rose to a sharp peak of 35 mg N/kg per hour, 4-4 1/2 h after the start of feeding (at 0830) and fell to a baseline level of 8.2 mg N/kg per hour between 0200 and 0800. Urea excretion remained relatively steady at a mean rate of 2.2 mg N/kg per hour throughout the day, showing no diurnal response to feeding. Starved fish showed a nitrogen excretion rate close to that for both the steady state of urea excretion and the baseline rate of ammonia excretion of the fed fish. Oxygen consumption rose to a peak of 370 mg O₂/kg per hour just before and during a 1-h feeding period, decreasing thereafter to a low of 170 mg O₂/kg per hour at 0300 h. For the starved fish this diurnal metabolic fluctuation continued from the start in a variable and diminishing form whereas nitrogen excretion showed no such response. The results are discussed in relation to hatchery observations. We conclude that for nonstressed salmon at 15 C ammonia is the chief excretory product of exogenous nitrogen metabolism.

75-000439 Brooke, L. T. (Cent. Lake Superior Environ. Stud., Univ. Wis., Superior 58440) EFFECT OF DIFFERENT CONSTANT INCUBATION TEMPERATURES ON EGG SURVIVAL AND EMBRYONIC DEVELOPMENT IN LAKE WHITEFISH (*COREGONUS CLUPEAFORMIS*). Trans. Am. Fish. Soc. 104 (3): 555-559. July 1975. SFA 20 (4).

Eggs of lake whitefish (*Coregonus clupeaformis*) were incubated in a constant-flow incubator at constant temperatures of 0.5, 2.0, 4.0, 5.9, 7.8, and 10.0 C. The time from fertilization to median hatch was inversely related to temperature, and ranged from 41.7 days at 10.0 C to 182 days at 0.5 C. The percentage hatch was highest (70.9-73.3 percent) at 4.0, 5.9, and 7.8 C, and was greatly reduced (6.0-28.4 percent) at 0.5, 2.0, and 10.0 C. The mortality of embryos was greatest during the early stages of development. Abnormally developed fry were most frequent (85.9 percent of the hatch) at 10.0 C, and least frequent (2.8 percent) at 4.0 C. Mean lengths of fry at hatching were shorter at 7.8 and 10.0 C (12.4 and 8.8 mm, respectively) than at lower temperatures (13.1 to 13.5 mm). The optimum temperature range for incubation of lake whitefish eggs was 3.2 to 8.1 C. Equations were derived for predicting development time to 20 successive stages, and to hatching, at constant incubation temperatures and at fluctuating daily mean water temperatures.

75-000440 Courtois, L. A. (Calif. Dep. Fish Game, Water Pollut. Contr. Lab., Rancho Cordova 95670) BLOOD AND SERUM ANALYSES OF ADULT STRIPED BASS, /MORONE SAXATILIS/, CAPTURED IN THE SACRAMENTO RIVER. Calif. Fish Game 61 (4): 245-246. Oct. 1975. SFA 20 (4).

75-000441 Davis, J. C. (Fish. Mar. Serv., Pacific Environ. Inst., West Vancouver, BC V7V 1N6, Canada) MINIMAL DISSOLVED OXYGEN REQUIREMENTS OF AQUATIC LIFE WITH EMPHASIS ON CANADIAN SPECIES: A REVIEW. J. Fish. Res. Board Can. 32 (12): 2295-2332. Dec. 1975. In English with French summ. SFA 20 (4).

This article reviews the sensitivity, responses, response thresholds, and minimum oxygen requirements of marine and freshwater organisms with strong emphasis on Canadian species. The analysis attempts to define low dissolved oxygen thresholds which produce some physiological, behavioral, or other response in different species.

Oxygen availability is discussed with reference to seasonal, geographical, or spatial variation in dissolved oxygen. Factors affecting availability of dissolved oxygen include atmospheric exchange, mixing of water masses, upwelling, respiration, photosynthesis, ice cover, and physical factors such as temperature and salinity. Dissolved oxygen terminology is summarized and tables are included for both fresh and saltwater O(2) solubility at different temperatures.

Encipient O(2) response thresholds are used in a statistical analysis to develop oxygen criteria for safeguarding various groups of freshwater and marine fish. These include mixed freshwater fish populations including or excluding salmonids, freshwater salmonid populations, salmonid larvae or mature salmonid eggs, marine anadromous and nonanadromous species. Criteria are based on threshold oxygen levels which influence fish behavior, blood O(2) saturation, metabolic rate, swimming ability, viability and normal development of eggs and larvae, growth, circulatory dynamics, ventilation, gaseous exchange, and sensitivity to toxic stresses. The criteria provide three levels of protection for each fish group and are expressed as percentage oxygen saturation for a range of seasonal temperature maxima.

Oxygen tolerances and responses of aquatic invertebrates to low oxygen are reviewed for freshwater and marine species according to habitat. No invertebrate criteria are proposed owing to the capacity for many invertebrate species to adopt anaerobic metabolism during low O(2) stress. It is suggested that the criteria proposed for fish species will provide a reasonable safeguard to most invertebrate species. It appears likely, however, that a change in oxygen regime to one of increased O(2) scarcity will probably influence invertebrate community structure.

It is suggested that criteria for protection of aquatic life be implemented by groups of experienced individuals. The group should consider the natural oxygen regime for a specific water body and its natural variability, the aquatic life therein and its value, importance, relative O(2) sensitivity, and the possibility of interactions with toxicants and other factors that may compound the stress produced by low O(2) on aquatic life. Each water body and its aquatic life should be considered as a unique situation and criteria application should not encompass diverse areas, habitats, or biological associations as if they were identical.

75-000442 de Vlaming, V. L. (Biol. Dep., Marquette Univ., Milwaukee, WI 53033) EFFECTS OF PHOTOPERIOD-TEMPERATURE REGIMES AND PINEALECTOMY ON BODY FAT RESERVES IN THE GOLDEN SHINER, /NOTEMIGONUS CRYSOLEUCAS/. NOAA Fish. Bull. 73 (4): 766-776. Oct. 1975. SFA 20 (4).

Various photoperiod-temperature regimes were examined for their effects on total fat content (excluding gonads) in /Notemigonus crysoleucas/; experiments were conducted during several different phases of the reproductive cycle. In /Notemigonus/, fattening normally occurs in fall and early winter concomitant with the early phases of gonadal development. Body fat stores are progressively depleted during the prespawning and spawning seasons. Warm temperature (25° C) normally favored body fat depletion in /Notemigonus/. Short photoperiod (9L/15D) accentuated the lipid depleteng effects of warm temperatures. Low temperatures (12°-15° C) usually promoted lipid deposition. Short photoperiods complimented the lipid anabolic effects of low temperatures. Thus, a given photoperiod can have opposite effects on body fat levels depending on temperature. A long photoperiod, in combination with warm temperatures, is required for final gonadal maturation and results in a reduction of lipid reserves. Short photoperiod-warm temperature regimes have similar effects on fat levels, but bring about gonadal regression. Thus, the effects of photoperiod-temperature regimes on lipid metabolism are apparently not totally dependent on the effects of these environmental factors on reproduction.

The effects of pinealectomy on lipid reserves varied depending on the phase of the natural reproductive cycle when the organ was removed, as well as, with the photoperiod-temperature regime under which the experimental animals were maintained. At 25° C and under a 15.5L/8.5D photoperiod, fat levels were frequently lower in pinealectomized than in sham animals. The opposite was usually true for fish exposed to a 9L/15D-25° C regime. Lipid reserves were normally greater in pinealectomized than in sham operated fish maintained on 15.5L/8.5D-12° C regime. Body fat composition was frequently less in pinealectomized than in sham operated animals exposed to a 9L/15D-12° C regime. Pinealectomy reverses the effects of photoperiod on lipid metabolism at a particular temperature. These results suggest that the pineal body is involved in regulating physiological functions and may serve as a photoreceptor and/or transducer of photoperiod information.

75-000443 Dwyer, W. P.; Kramer, R. H. (U.S. FWS, Rt. 2, Box 333, Bozeman, MT 59715) THE INFLUENCE OF TEMPERATURE ON SCOPE FOR ACTIVITY IN CUTTHROAT TROUT, /SALMO CLARKI/. Trans. Am. Fish. Soc. 104 (3): 552-554. July 1975. SFA 20 (4).

One hundred eleven active and 71 standard metabolic rate estimates were made on 90-g cutthroat trout /Salmo clarki/ at five temperatures. Active metabolism was lowest at 5 C (363 mg O(2)/kg-h) and highest at 15 C (597 mg O(2)/kg-h). At 20 C and 24 C it was 559 and 491 mg/kg-h, respectively. Scope for activity ranged from a low of 316 mgO(2)/kg-h at 5 C to a high of 486 mg O(2)/kg-h at 15 C then down to 374 mg O(2)/kg-h at 24 C. Standard metabolisms at 5, 10, 15, 20, and 24 C were 47, 73, 111, 129, and 117 mg O(2)/kg-h respectively.

75-000444 Gonzalez, D. R.; Padron, M.; Subero, L. E. (Inst. Oceanogr., Univ. Oriente, Cumana, Venezuela) ANALISIS ELECTROFORETICO DE HEMOGLOBINA, LACTATO DESHIDROGENASA, ESTERASAS Y PROTEINAS NO ENZIMATICAS DE DOS ESPECIES DEL GENERO ANCHOA (PICES: ENGRAULIDAE). [ELECTROPHORETIC ANALYSIS OF HEMOGLOBIN, LACTATE DEHYDROGENASE, ESTERASES AND NON-ENZYMATIC PROTIENS OF TWO SPECIES OF THE GENUS /ANCHOA/ (PISCES: ENGRAULIDAE).] Bol. Inst. Oceanogr. Univ. Oriente Cumana 13 (1-2): 47-52. Dec. 1974. In Spanish with English summ. SFA 20 (4).

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The results of an electrophoretic study of 67 specimens of *Anchoa hepsetus*/ "banda ancha" group, and 42 of *A. lamprotaenia*/ are presented in this paper. These species were collected during 21 cruises carried out from February 1972 to February 1974, along the Northeastern coast of Venezuela. Proteins: hemoglobin (Hb), lactate dehydrogenase (LDH), esterases (Es) and non-enzymatic proteins (PG) were analyzed and it was found that there is 63 percent of basic identity in regard to these constituents, indicating a very similar genetic basis for both species. However, it was further noticed that the nature of some these proteins may be useful as a new taxonomic criterion for differentiating *A. hepsetus*/ from *A. lamprotaenia*/.

75-000445 Hayden, J. B.; Chech, J. J., Jr.; Bridges, D. W. (Univ. Vt., Coll. Med., Burlington 05401) BLOOD OXYGEN DISSOCIATION CHARACTERISTICS OF THE WINTER FLOUNDER, *PSEUDOPLEURONECTES AMERICANUS*/. J. Fish. Res. Board Can. 32 (9): 1539-1544. Sept. 1975. In English with French summ. SFA 20(4).

Oxygen dissociation curves were determined for winter flounder (*Pseudopleuronectes americanus*/) blood at 5, 10, and 15 C, and P(CO) (2) = less than 1, 8, and 24 mm Hg. Half-saturation tensions (P(50)'s) and blood oxygen capacities were measured and showed significant Bohr and Root effects. Calculations of Hill's constant, n , implied no heme-heme interaction in the flounder hemoglobin. The apparent heat of oxygenation, ΔH , was calculated to be smaller than that in most teleostean hemoglobins. This small temperature effect, together with the modest slope of the hyperbolic oxygen dissociation curves, indicate a capacity to live in waters exhibiting a fairly broad range of temperatures and dissolved oxygen concentrations.

75-000446 Holub, B. J.; Nilsson, K.; Piekarski, J.; Slinger, S. J. (Coll. Biol. Sci., Univ. Guelph, Guelph, ON N1G 2W1, Canada) BIOSYNTHESIS OF LECITHIN BY THE CDP-CHOLINE PATHWAY IN LIVER MICROSOMES OF RAINBOW TROUT, *SALMO GAIARDNERI*/. J. Fish. Res. Board Can. 32 (9): 1633-1637. Sept. 1975. In English with French summ. SFA 20(4).

The enzymatic synthesis of lecithin from CDP-choline (^{14}C) was characterized in microsomal preparations from the livers of rainbow trout (*Salmo gairdneri*/). Optimal activity was obtained with the addition of 1,2-diglyceride and Mg^{++} to the incubation medium. There was a 290 percent stimulation in cholinephosphotransferase activity when the incubation temperature was raised from 15 to 37 C. The results indicate that the CDP-choline pathway is operative in the formation of lecithin in the liver of rainbow trout. The possible function of this reaction in the acclimation of fish to environmental temperature is discussed.

75-000447 Neumann, D. A.; O'Connor, J. M.; Sherk, J. A.; Wood, K. V. (Aquatic Ecol. Assoc., 5100 Centre Ave., Pittsburg, PA 15232) RESPIRATORY AND HEMATOLOGICAL RESPONSES OF OYSTER TOADFISH (*OPSANUS TAU*/) TO SUSPENDED SOLIDS. Trans. Am. Fish. Soc. 104 (4): 775-781. Oct. 1975. SFA 20(4).

Respiration rates of *Opsanus tau*/ in suspensions of fuller's earth (2.20 g/liter) and in resuspended Patuxent River sediment (1.58 g/liter) did not differ significantly from rates of fish in filtered water. Oxygen consumption rates of fish exposed to Patuxent River sediments (3.36 g/liter) after 72 h exposure to 11.09 g/liter of the same material exhibited significantly greater (P less than 0.05) variance than control fish. Respiration rates of fish tested in filtered water after 72 h exposure to 10.37 g/liter of Patuxent River sediment were not different from those of control fish. Respiration

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variances differed between males and females only in Patuxent River sediment suspensions. Fish held in Patuxent River sediment suspensions of 14.6 g/liter for 72 h exhibited no significant changes in erythrocyte count, hemoglobin concentration, microhematocrit, or blood osmolal concentration compared with control fish. Toadfish appear to be largely unaffected by highly turbid conditions.

75-000448 Newsome, G. E.; Leduc, G. (Dep. Biol., St. Francis Xavier Univ., Antigonish, NS, Canada) SEASONAL CHANGES OF FAT CONTENT IN THE YELLOW PERCH (*PERCA FLAVESCENS*) OF TWO LAURENTIAN LAKES. J. Fish Res. Board Can. 32 (11): 2214-2221. Nov. 1975. In English with French summ. SFA 20(4).

Different body fat reserves in male and female yellow perch (*Perca flavescens*) may determine a marked differential mortality during the winter. This was revealed by a study in two Laurentian lakes of the Province of Quebec harboring stunted yellow perch with a marked predominance of males. The proportion of females in each year-class is markedly smaller, thus suggesting a higher mortality among immature and mature females than among males.

In an attempt to explain the differential mortality, the seasonal variation of body fat content in males and females was measured; also the fat level at time of death caused by starvation under laboratory conditions was determined. The results showed that in the females the body fat content falls to a critical level of about 2 percent at least 4 mo before spawning, whereas the males maintain a fat level of almost 5 percent throughout the winter.

75-000449 Shireman, J. V. (Univ. Fla., Gainesville 32611) GONADAL DEVELOPMENT OF STRIPED MULLET (*MUGIL CEPHALUS*) IN FRESHWATER. Prog. Fish-Cult. 37 (4): 205-208. Oct. 1975. SFA 20(4).

Striped mullet (*Mugil cephalus*) were collected from two freshwater habitats in south Louisiana, in order to determine the extent of gonadal development. Microscopic examination of the gonads indicated that both sexes developed normally in fresh water. Mature fish migrated to the Gulf of Mexico to spawn or began to resorb their gonadal products, whereas immature fish remained within the study area. It is postulated that sexually mature fish raised in fresh water could be used for brood stock in culture operations.

BEHAVIOR

75-000450 Beitinger, T. L.; Magnuson, J. J. (Dep. Zool., Univ. Wis., Madison 53706) INFLUENCE OF SOCIAL RANK AND SIZE ON THERMOSELECTION BEHAVIOR OF BLUEGILL (*LEPOMIS MACROCHIRUS*). J. Fish. Res. Board Can. 32 (11): 2133-2136. Nov. 1975. In English with French summ. SFA 20(4).

Juvenile bluegill (*Lepomis macrochirus*) (95-110 mm TL) were given a choice between an environment at their preferred temperature (31.0 C) plus a social dominant (130-160 mm TL) or an environment either cooler (27.0 C) or warmer (34.0 C) than their preferred temperature, but without a large bluegill. During a 3-day control period, when 20 small fish were isolated in individual experimental aquaria, each spent more than 75 percent of its time at 31.0 C rather than warmer or cooler temperatures. After an adult was placed into the preferred temperature side of each aquaria, small fish spent nearly the entire 3-day experimental period at previously nonpreferred temperatures on the side without the larger bluegill. No significant correlation ($r = -0.03$) was found between length and selected temperatures of 35

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individual bluegill (70-140 mm) tested in a temporal temperature gradient.

75-000451 Ellgaard, E. G.; Bloom, K. S.; Malizia, A. A., Jr.; Gunning, G. E.; Jensen, R. E. (Dep. Biol., Tulane Univ., New Orleans, LA 70118) THE LOCOMOTOR ACTIVITY OF FISH: AN ANALOGY TO THE KINETICS OF AN OPPOSED FIRST-ORDER CHEMICAL REACTION. Trans. Am. Fish. Soc. 104 (4): 752-754. Oct. 1975. SFA 20(4).

The kinetic behavior of a laboratory population of bluegill (*Lepomis macrochirus*) under defined laboratory conditions is shown to be analogous to the reaction kinetics described by a population of molecules engaged in a opposed (reversible) first-order reaction. Thus as in chemical kinetics, the locomotor activity of fish can be described quantitatively in the form of rate constants.

75-000452 Gibson, R. J.; Power, G. (Dep. Biol., Woods Hole Oceanogr. Inst., Woods Hole, MA 02543) SELECTION BY BROOK TROUT (*SALVELINUS FONTINALIS*) AND JUVENILE ATLANTIC SALMON (*SALMO SALAR*) OF SHADE RELATED TO WATER DEPTH. J. Fish. Res. Board Can. 32 (9): 1652-1656. Sept. 1975. In English with French summ. SFA 20(4).

Salmon parr and small brook trout were observed in two stream tanks providing choices of cover. One tank was shallow (24-29 cm) and the other deep (43-50 cm). In the shallow tank brook trout occurred most frequently in shade. When salmon were the sole species, they were most frequently in shade, but were mostly away from shade in the presence of trout. This selection for shade was not evident by either species in the deep tank.

75-000453 Hoglund, L. B.; Bohman, A.; Nilsson, N. (Inst. Zoophysiol., Univ. Uppsala, Sweden) POSSIBLE ODOUR RESPONSES OF JUVENILE ARCTIC CHAR (*SALVELINUS ALPINUS* (L.)) TO THREE OTHER SPECIES OF SUBARCTIC FISH. Rep. Inst. Freshwater Res. Drottningholm No. 54: 21-35. 1975. SFA 20(4).

Reactions of juvenile Arctic char (*Salvenius alpinus* (L.)) to chemical stimulation, presumably odour(s) released into the water by the presence of any three other subarctic fish species, were studied quantitatively by means of the fluvium technique. In five out of seven tests second-summer char showed clear avoidance to intact as well as to dead whitefish (*Coregonus lavaretus* (L.)). In the other two tests the reactions were indifferent. Two tests using intact vendace or cisco (*Coregonus albula* (L.)) as "odour donor" also gave no significant reaction, but avoidance was noted in two tests with injured cisco. Brown trout (*Salmo trutta* L.) gave rise to significant avoidance in one test, but to slight attraction in the other four tests performed. The present results have been compared with earlier findings regarding intraspecific attraction among juvenile Arctic char. The interspecific avoidance behaviour of juvenile char versus whitefish observed in the present tests has been discussed as a possible guiding factor in interactive segregation. The term "odour aversion" is suggested as a designation for the phenomenon of restriction in behaviour and occurrence of one species on account of such olfactory responses in the field situation. (Auth. Summ.)

75-000454 Kennedy, G. J. A.; Pitcher, T. J. (Fish. Res. Lab., The Cutts, Coleraine, Northern Ireland) EXPERIMENTS ON HOMING IN SHOALS OF THE EUROPEAN MINNOW, /PHOXINUS PHOXINUS/ (L). Trans. Am. Fish. Soc. 104 (3): 454-457. July 1975. SFA 20(4).

Groups of minnows accepted home ranges in aquarium tanks and did not stray from their home area when an exit route leading to a similar area was available. Minnows actively homed when displaced in a reciprocal transfer between two ranges in the tank. The degree of homing depended on the length of time the minnows had been kept in their home areas initially, and homing was well established after five weeks.

75-000455 Kutty, M. N.; Sukumaran, N. (Dep. Biol. Sci., Madurai Univ., Madurai-625021, India) INFLUENCE OF UPPER AND LOWER TEMPERATURE EXTREMES ON THE SWIMMING PERFORMANCE OF /TILAPIA MOSSAMBICA/. Trans. Am. Fish. Soc. 104 (4): 755-761. Oct. 1975. SFA 20(4).

/Tilapia mossambica/ (mean size: 13 cm) acclimated to 30 C in fresh water and forced to swim at current speeds of 36, 66, and 82 cm/s in Blazka's activity apparatus failed to swim at 39.7, 38.4, and 37.0 C respectively, when the temperature of ambient water was gradually increased from the acclimation temperature. The lower critical temperatures of swimming failure at the same three swimming speeds were 17.4, 18.8, and 19.8 C, respectively. The pattern of swimming failure at the critical temperature was similar to that at critical ambient oxygen concentrations. At both the upper and lower critical zones fish swam steadily again when the temperature stress was reduced. The upper avoidance temperature of /T. mossambica/ in relatively quiet water was much lower than the upper critical temperatures of swimming failure. Since such failures do not incapacitate the fish from further performance and since the critical temperatures can be considered as points in a temperature gradient in running water, it appears that these temperatures are indicative of a thermal avoidance in running water.

75-000456 Pitcher, T. J. (Sch. Biol. Environ. Stud., New Univ. Ulster, Coleraine, Northern Ireland) A PERISCOPIC METHOD FOR DETERMINING THE THREE-DIMENSIONAL POSITIONS OF FISH IN SCHOOLS. J. Fish. Res. Board Can. 32 (9): 1533-1538. Sept. 1975. In English with French summ. SFA 20(4).

The Cartesian coordinates of fish schooling in aquarium tanks are estimated by combining a periscope image via mirrors with a direct view on one photograph. Systematic errors from simple geometrical estimates based on parallax are accurately compensated by calibration using multiple polynomial regression. Once calibration has been carried out, the periscope method has advantages over others in using standard photographic equipment, in reducing measuring time, and in the identification of fish.

75-000457 Quertermus, C. J., Jr. (Biol. Dep., West Ga. Coll., Carrollton 30117) PRIOR EXPERIENCE AS A FACTOR IN HABITAT SELECTION BY THE CICHLID FISH /TILAPIA MOSSAMBICA/. Trans. Am. Fish. Soc. 104 (4): 742-751. Oct. 1975. SFA 20(4).

The African cichlid fish, /Tilapia mossambica/ (Peters), was selected for investigation of the role that prior-habitat experience may play in determining the choice of a resting habitat by fish. Fish were reared in different habitats and later tested for habitat selection. Three regimes were used (early, late, and continuous). Early-experience fish experienced a habitat the first 60 days of free-swimming; late-experience fish, the last 60 days before testing; and

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continuous-experience fish, from the time of free-swimming to testing. Half of the fish were tested at 4 months and half and 8 months. Each individual was observed for 1 hour during a 2-day period in an experimental tank, offering a choice of habitats.

Early and continuous-experience fish (both 4 and 8 months) selected the conditioning habitat on the second day in the testing tank as measured by total time and number of habitat visits. Late-experience fish failed to select the conditioning habitat. Thus early experience (before sexual maturity) is not only a sufficient, but also a necessary, condition for habitat fixation in *Tilapia mossambica* as judged by short term selection of 2 days. These results are discussed in relation to behavioral activities and the relationship of stress to habitat selection.

75-000458 Reingold, M. (Idaho Dep. Fish Game, Salmon 83467) EFFECTS OF DISPLACING, HOOKING, AND RELEASING ON MIGRATING ADULT STEELHEAD TROUT. Trans. Am. Fish. Soc. 104 (3): 458-460. July 1975. SFA 20(4).

Upstream migrating adult steelhead trout (*Salmo gairdneri*), transported downstream, hooked, and played to exhaustion, returned to their target spawning stream equally as well as fish just transported and released. The number of fish returning to their home stream was inversely related to the distance transported and appears to directly related to the number of days remaining before spawning.

75-000459 Richkus, W. A. (Environ. Tech. Cent., Martin Marietta Corp., 1450 S. Rolling Rd., Baltimore, MD 21227) THE RESPONSE OF JUVENILE ALEWIVES TO WATER CURRENTS IN AN EXPERIMENTAL CHAMBER. Trans. Am. Fish. Soc. 104 (3): 494-498. July 1975. SFA 20(4).

The response of juvenile alewives to water currents in an experimental chamber was examined. Fish showed greater movement from the center of the chamber when water was flowing than when under static conditions. Fish oriented strongly to currents, and their direction of movement may have been influenced by current velocity. Responses to currents were similar in fresh and seawater.

75-000460 Sutterlin, A. M.; Waddy, S. (Fish. Mar. Serv., Biol. Stn., St. Andrews, NB E0G 2X0, Canada) POSSIBLE ROLE OF THE POSTERIOR LATERAL LINE IN OBSTACLE ENTRAINMENT BY BROOK TROUT (*SALVELINUS FONTINALIS*). J. Fish. Res. Board Can. 32 (12): 2441-2446. Dec. 1975. In English with French summ. SFA 20(4).

Observations of position holding by brook trout (*Salvelinus fontinalis*) in a stream channel indicate that they choose specific locations probably related to flow patterns around bottom obstructions. Bilateral denervation of the posterior lateral line system of trout has no effect on their ability to entrain on objects placed in flowing water, providing sufficient visual cues are available. Unilateral ablation resulted in a lateral bias in swimming position relative to the flow obstruction even when visual cues were present. Bilateral denervation of the posterior line system reduced the degree to which trout could entrain on objects when visual cues were omitted. It is suggested that in stream-dwelling fish, such as the brook trout, the lateral line may serve as a detector of flow or pressure discontinuities, enabling the fish to maintain position with minimum expenditure of energy.

LIFE HISTORIES-GENERAL WORKS

75-000461 Bray, R. N.; Ebeling, A. W. (Mar. Sci. Inst. Dep. Biol. Sci., Univ. Calif., Santa Barbara 93106) FOOD, ACTIVITY, AND HABITAT OF THREE "PICKER-TYPE" MICROCARNIVOROUS FISHES IN THE KELP FORESTS OFF SANTA BARBARA, CALIFORNIA. NOAA Fish. Bull. 73 (4): 815-829. Oct. 1975. SFA 20(4).

Diets, daily activity, and habitat preference were compared between the kelp perch, *Brachyistius frenatus*; the seniorita, *Oxyjulis californica*; and the white seaperch, *Phanerodon furcatus*, all of which co-occur in areas of reef and kelp off Santa Barbara, Calif. The kelp perch and seniorita often clean ectoparasites off larger host fishes, whereas the white seaperch is a more generalized picker-type microcarnivore.

The kelp perch and seniorita, which co-occur in the kelp canopy, showed the least amount of total overlap in resource use, expressed as a combination of individual overlaps in food, activity, and habitat. The seniorita had the narrowest breadth of diet but the widest breadth of habitat (within the kelp-bed areas). Senioritas and white seaperch ate mostly bryozoans incrusting on plants, whereas kelp perch ate mostly plankton and other tiny motile prey. As species, neither the kelp perch nor the seniorita derives substantial amounts of food from cleaning, although some individual senioritas may. Unlike the two "cleaners," the white seaperch also ate substantial numbers of bottom prey. None of the species forage at night, when all are relatively inactive, and when the seniorita actually buries itself in patches of rubble and sand on the reef. The two perches showed the greatest overlap in daytime activity, as measured both by bi-hourly counts of feeding bites in the field and of swimming movements in a laboratory tank.

75-000462 Heins, D. C.; Bresnick, G. I. (Dep. Biol., Tulane Univ., New Orleans, LA 70118) THE ECOLOGICAL LIFE HISTORY OF THE CHERRYFIN SHINER, *NOTROPIS ROSEIPINNIS*. Trans. Am. Fish. Soc. 104 (3) 516-523. July 1975. SFA 20(4).

Notropis roseipinnis is a small southern minnow inhabiting small tributary streams in the Gulf Coastal Plain typified by rapidly fluctuating environmental conditions. The reproductive season extends from late March into August or early September in the Jourdan River system, Hancock County, Mississippi. The sex ratio was not different from 1:1 and the mean sizes of males and females were similar. Most fish were mature by about 30 mm standard length (SL). The number of mature ova was correlated with the size of the female, ranging from 50 to 293 for females 29.6-46.6 mm SL. There were significant differences in the number of mature ova with time. Two peaks were indicated, one at the beginning of the productive season and one in the latter half. The mean diameter of mature ova (0.65-0.85 mm, mean 0.77) was not significantly correlated with fish length.

75-000463 Moen, T. E. (U.S. FWS, North Cent. Reservoir Invest., Mobridge, SD 57601) POPULATION TRENDS, GROWTH, AND MOVEMENTS OF BIGMOUTH BUFFALO, *ICTIOBUS CYPRINELLUS*, IN LAKE OAHE, 1963-70. U.S. Fish. Wildl. Serv. Tech. Pap. 78. 20p. 1974. SFA 20(4).

The bigmouth buffalo, *Ictiobus cyprinellus*, is the most important commercial species in Lake Oahe, a reservoir in the upper Missouri River. The population was dominated by three strong year classes (1959, 1960, and 1962). Estimated population in the fall of 1964 was 540,000 fish of the combined 1959-60 year classes and 5 million of the 1962 year class (equivalent to 81 kg per hectare). Abundance declined

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irregularly during 1964-70. Annual landings of these two dominant groups during 1965-70 ranged from 149 to 271 metric tons. The total landings during the period amounted to about 151,800 fish of the 1959-60 year classes and 313,000 fish of the 1962 year class.

Growth rate was high during the first few years of impoundment and then declined. Males and females grew at about the same rate for the first 4 yr of life, but females were longer and heavier than males at ages V-VIII. At these ages, fish of the 1962 year class were about 10 percent shorter and 36 percent lighter than those of the 1959 year class. Growth of tagged and untagged fish was similar. The number of females per male increased with age. Age at maturity increased slightly as growth rate declined.

Movement of marked fish was extensive and the recapture of marked fish was directly related to size of fish, location of release, and subsequent fishing pressure; 44 percent were recaptured downstream from the point of release, and 38 percent upstream. Females showed a stronger tendency to move downstream than males. Maximum distance traveled was 380 km and maximum rate of travel was 6.4 km per day.

Successful reproduction appeared to be associated with flooding of shoreling vegetation during spring and early summer. Inasmuch as little such flooding is expected in the future, annual landings of bigmouth buffalo will probably continue to decline sharply.

75-000464 Starostka, V. J.; Nelson, W. R. (Dutch John, UT) AGE, GROWTH, SEXUAL MATURITY, AND FOOD OF CHANNEL CATFISH IN CENTRAL LAKE OAHE, 1968-69. U.S. Fish Wildl. Serv. Tech. Pap. 81. 13p. 1974. SFA 20(4).

Channel catfish, *Ictalurus punctatus*, were collected with gill nets, trawl, and trap nets at three localities in Lake Oahe for the study of year-class strength, growth in length and weight, age composition, sexual maturity, and food.

Fish were recruited to all the collection gears at age II. Relatively strong year classes were produced in 1962, 1965, and 1966. Youngest fish were captured in the upper end of the Moreau River embayment, which apparently serves as a nursery area.

Growth of age 0 fish was poor probably because the growing season was short; optimum spawning temperatures were not reached until mid-summer. Growth of age II and older fish reached a peak in 1963 and declined rather steadily in 1964-68. Males began to mature at age VIII, and all fish of both sexes were mature at age XI.

The diet changed from zooplankton to fish as channel catfish increased in length; aquatic insects (primarily chironomid larvae and pupae) were important foods for fish of all sizes. Fish less than 300 mm long selected large zooplankters--*Leptodora kindtii* and *Daphnia* spp--over smaller copepods. Larger channel catfish ate principally yellow perch, *Perca flavescens*.

75-000465 Wallace, J. H.; van der Elst, R. P. (Oceanogr. Res. Inst., P.O. Box 736, Durban 4000, South Africa) THE ESTUARINE FISHES OF THE EAST COAST OF SOUTH AFRICA. IV. OCCURRENCE OF JUVENILES IN ESTUARIES. V. ECOLOGY, ESTUARINE DEPENDENCE AND STATUS. S. Afr. Assoc. Mar. Biol. Res., Invest. Rep. No. 42. 63p. Nov. 1975. Available from: The Librarian, Oceanogr. Res. Inst., P.O. Box 736, Durban 4000, South Africa. SFA 20(4).

Juveniles of 54 species of fish have been recorded in Natal estuaries. Of these, twenty are angling species and ten non-angling species valuable as human food. Most of the species in Natal estuaries are sub-tropical in distribution with the result that their abundance declines towards the south-west. Juveniles generally have a more restricted range than adults. Juveniles of species such as *Liza dumerili*, *Mugil cephalus* and *Rhabdosargus holubi*, occur in

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estuaries along the whole of the East and South coasts. Juveniles of certain South Coast species do not extend into Natal estuaries. Estimates of early growth rates have been made for *M. cephalus*, *Pomadasys commersonni*, *R. sarba*, *R. holubi*, and *Acanthopagrus berda*. Shallow areas that support marginal and submerged aquatic vegetation form particularly favourable habitats for juvenile fishes and play a major role in the function of estuaries as fish nurseries. Habitat preferences of numerous species are described. The influence of hypersaline conditions on the juvenile fish fauna and the ecological role of hippo in maintaining the nursery function on St. Lucia lake are discussed. Attention is drawn to the fact that juveniles of a number of important species start migrating into Natal estuaries at lengths of less than 2cm and complete their most active recruitment phase by the time a length of 5cm is attained. An additional 21 species start entering estuaries at lengths of between 1-6cm. In open estuaries most immigration takes place during winter and spring when river outflow is at a minimum and begins to increase at the start of the wet season. In blind estuaries recruitment usually starts during spring when increased river flow forces open estuary mouths. Evidence is presented to show that very large numbers of juveniles utilise the estuarine environment and then return to sea to supplement the marine stocks. (From Auth. Summ. and Concl.)

75-000466 Wallace, J. H. (Oceanogr. Res. Inst., P.O. Box 736, Durban 4000, South Africa) THE ESTUARINE FISHES OF THE EAST COAST OF SOUTH AFRICA. I. SPECIES COMPOSITION AND LENGTH DISTRIBUTION IN THE ESTUARINE AND MARINE ENVIRONMENTS. II. SEASONAL ABUNDANCE AND MIGRATIONS. S. Afr. Assoc. Mar. Biol. Res., Invest. Rep. No. 40. 72p. Nov. 1975. Available from: The Librarian, Oceanogr. Res. Inst., P.O. Box 736, Durban 4000, South Africa. SFA 20(4).

In general, juvenile fishes are much more abundant in estuaries than adults. Catches decline rapidly as the size of juveniles increases. This appears to be largely attributable to mortality caused by bird and fish predation. Adolescent fish are poorly represented in estuarine catches and this is partly due to emigration to sea in preparation for the adult reproductive phase of life. Adult populations tend to occur mainly at sea, only a relatively small proportion returning to estuaries. In some species the largest length classes are exclusively marine. The distinction between the juvenile and adult phases of the life cycle is more marked in the large St. Lucia lake system than in smaller estuaries where interchange with the sea takes place more easily. A few species occur in estuaries throughout their lives as they spawn in this environment. Most estuarine fish are inshore and shallow-water continental shelf species. The abundance of juveniles in the estuarine environment leads to the conclusion that its most important function in the biology of these species is the provision of a nursery habitat for juveniles.

The first migration undertaken by most species is the movement of fry from the sea into estuaries. Species such as *Pomadasys commersonni*, *Rhabdosargus sarba* and *R. holubi* start to return to sea after about a year, at which stage they are still sexually immature. *Mugil cephalus* remains in the St. Lucia system for an estimated 3-4 years before sexually mature adults undergo a seaward spawning migration. Interchange between the sea and populations in small estuaries seems to be more frequent than in large systems such as St. Lucia. Migrations and changes in seasonal abundance of sexually mature fish tend to be associated with the spawning season and many migrants are in pre- and post-spawning condition. However some species migrate between these environments during the inactive phase of their reproductive cycles. In a number of species the period of inshore abundance coincides with the spawning season. The inshore spawning shoals appear to be formed by emigrants from estuaries and from an

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inshore movement of marine populations. Longshore migrants are also likely to contribute to these shoals. Seasonal shifts in distribution along the East and South coasts occur and are associated with changes in water temperature. Sub-tropical East Coast species extend into South Coast waters in summer and warm temperate species enter East Coast waters during winter. It is probable that these longshore migrations are assisted by the Agulhas Current and possibly by an inshore north-flowing counter current. (From Auth. Summ. and Concl.)

POPULATION STUDIES, PRODUCTION, ETC.

75-000467 Busch, W.-D. N.; Scholl, R. L.; Hartman, W. L. (U.S. FWS, Biol. Stn., Sandusky, OH 44870) ENVIRONMENTAL FACTORS AFFECTING THE STRENGTH OF WALLEYE (/STIZOSTEDION VITREUM/) YEAR-CLASSES IN WESTERN LAKE ERIE, 1960-70. J. Fish. Res. Board Can. 32 (10): 1733-1743. Oct. 1975. In English with French summ. SFA 20 (4).

Commercial production of walleyes (/Stizostedion vitreum vitreum/) from western Lake Erie declined from 5.9 million pounds in 1956 to 140,000 pounds by 1969. Since 1956, marked irregularity in year-class success has developed. Only four year-classes were considered good during 1959-70. The rate and regularity of water warming during the spring spawning and incubation periods in 1960-70 had a positive effect of the density of egg deposits and the resulting year-class strength. Rates of warming were not themselves detrimental, but rather the extended length of the incubation period in cool springs increased the exposure of eggs to such negative influences as dislodgment from the spawning reefs by strong current action generated by spring storms, or siltation and low oxygen tensions. The annual brood stock size had much less influence on year-class strength than did water temperature. Reproductive success was unrelated to fluctuations in size of suitable reef spawning area caused by changes in water level. Apparently the usable spawning area at any water level is more than adequate to serve the limited walleye brood stocks.

75-000468 Lett, P. F.; Kohler, A. C.; Fitzgerald, D. N. (Fish. Mar. Serv., Biol. Stn., St. Andrews, NB E0G 2X0, Canada) ROLE OF STOCK BIOMASS AND TEMPERATURE IN RECRUITMENT OF SOUTHERN GULF OF ST. LAWRENCE ATLANTIC COD, /GADUS MORHUA/. J. Fish. Res. Board Can. 32 (9): 1613-1627. Sept. 1975. In English with French summ. SFA 20 (4).

A multivariate approach was used to elucidate the simultaneous effects of temperature and estimated parent stock biomass on the recruitment mechanism of Gulf of St. Lawrence cod. The second order effects of temperature and estimated stock biomass were key factors in determining egg abundance levels. In addition, egg abundance was closely related to the growth rate of cod. The numbers of larvae increased with the interaction of temperature with egg abundance but decreased with the interaction of egg abundance and time. The most important step in the recruitment mechanism occurs during the juvenile stage, the degree of density dependence being reliant on total biomass of the adult cod stock. A system simulation was constructed amalgamating the equations of early life history of cod with the effects of exploitation on stock biomass. Regular 12-yr oscillations were demonstrated at low levels of catch, while the population became more stable at higher fishing efforts in the absence of environmental effects. The optimal fishing mortality for the Gulf of St. Lawrence cod was found to be $F(0.4)$, with a maximum sustainable yield of 42,000 metric tons.

75-000469 Nakashima, B. S.; Leggett, W. C. (Dep. Biol., McGill Univ., Montreal, PQ, H3C 3G1, Canada) YELLOW PERCH (/PERCA FLAVESCENS/) BIOMASS RESPONSES TO DIFFERENT LEVELS OF PHYTOPLANKTON AND BENTHIC BIOMASS IN LAKE MEMPHREMAGOG, QUEBEC-VERMONT. J. Fish. Res. Board Can. 32 (12): 1785-1797. Oct. 1975. In English with French summ. SFA 20(4).

Perch biomass in Lake Memphremagog, Quebec was 2.5 times greater in the more productive south than in the less productive north basins. This difference is on the same order of magnitude as biomass differences in the phytoplankton (approximately 1.6X) and benthic (approximately 3X) communities. The difference in perch biomass is attributed to a larger perch population in the south basin. Growth was similar in both basins, and therefore independent of production at these lower trophic levels. Perch growth in both basins is maximal for the Quebec area and probably controlled by the length of the growing season. Abundance levels are fixed by the fourth year and possibly prior to reaching the second year of life. Perch biomass responses to different food levels in Lake Memphremagog provide empirical support to Moore's (1941) suggestion that at abundant food levels, population size and not growth is enhanced. Previous experiments defining the relation between growth and nutrient concentration and/or primary production did not fully represent the situation in Lake Memphremagog. This may have been due to conditions in simple, controlled systems not usually found in natural, complex ones.

75-000470 Ozcan, A. (Elazig Vet. Fac., Univ. Ankara, Elazig, Turkey) INTERRELATION OF DUNMORE HERRING STOCK WITH THE MANX HERRING STOCK. Ankara Univ. Vet. Fak. Derg. 2 (1): 53-67. 1975. In English with Turkish summ. SFA 20(4).

May-July herring catches to the west of the Isle of Man contain a varying percentages of winter spawning fish with higher vertebral count, which stay along the Manx waters up to it's third year and leave these waters for it's first spawning and never return to Manx.

There are evidences found that Dunmore herrings larvae and white bait penetrate into the Irish Sea. The evidence for the presence of the herring of Dunmore stock in the fishery to the west of the Isle of Man is further examined.

The changes in the wind direction of ten year period, over Dunmore ground, during the vertebral count of the larvae and subsequently changes occurred in the vertebral count of the west Isle of Man catches have been examined. It has been found that under easterly and north-easterly winds, Dunmore larvae penetrate into the Irish Sea which were detected by their high vertebral count. In the years with other winds dominant this penetration was not found.

The L(1) data of three and four years olds of the west Isle of Man herring also has been examined, and that in the years which easterly were dominant over Dunmore ground the distribution was different but during the others the distribution was similar.

Considering these evidences it is suggested that the component of Dunmore winter spawners in the west of Man fishery is dependant on the wind direction over the Dunmore spawning ground, during the hatching and early development period of the larvae. (Auth. Summ.)

75-000471 Phinney, D. E. (Alaska Dep. Fish Game, Kodiak 99615) REPOPULATION OF AN ERADICATED STREAM SECTION BY BROOK TROUT. Trans. Am. Fish. Soc. 104 (4): 685-687. Oct. 1975. SFA 20(4).

The rate of repopulation of a stream section treated with rotenone was studied by electrofishing. Brook trout from the unaffected areas upstream had completely repopulated the area after one year. The primary repopulation was by young-of-the-year trout.

SPAWNING HABITS AND MOVEMENTS, FECUNDITY, ETC.

75-000472 Able, K. W.; Castagna, M. (Biol. Dep., McGill Univ., Montreal, PQ, Canada) ASPECTS OF AN UNDESCRIBED REPRODUCTIVE BEHAVIOR IN /FUNDULUS HETEROCLITUS/ (PICES: CYPRINODONTAE) FROM VIRGINIA. Chesapeake Sci. 16 (4): 282-284. Dec. 1975. SFA 20(4).

Large numbers of eggs of /Fundulus heteroclitus/ have been found in shells of the intertidal mussel, /Modiolus demissus/, near Wachapreague, Virginia, during six consecutive summers and in Brown's Bay, Virginia, during 1972. Egg deposition in shells in aquaria has been observed. This behavior may serve to protect the eggs from predation. In nature the eggs in shells are exposed to high temperatures and desiccation for long periods during lower tide levels. Hatching has occurred in 14 to 17 days under these conditions. Eggs taken from mussel shells and eggs stripped and fertilized in the laboratory did not have chorionic filaments or the filaments were greatly reduced in number and length. The habit of egg deposition in shells and the morphology of the eggs are different from that reported for /F. heteroclitus/ from Woods Hole, Massachusetts.

75-000473 Bohlin, T. (Dep. Zool., Univ. Gothenburg, Sweden) A NOTE ON THE AGGRESSIVE BEHAVIOUR OF ADULT MALE SEA TROUT TOWARDS "PRECOCIOUS" MALES DURING SPAWNING. Rep. Inst. Freshwater Res. Drottningholm No. 54: 118. 1975. SFA 20(4).

75-000474 Brylinska, M.; Platt, C.; Sklinsmont, W. (Akad. Roln.-Tech., Olsztyn, Poland) ANALIZA ZALEZNOSCI MIEDZY WYBRANYMI WSKAZNIKAMI PLODNOSCI LESZCZA, A WSKAZNIKAMI WARUNKOW SRODOWISKA. [ANALYSIS OF RELATION BETWEEN THE SELECTED FECUNDITY INDICES IN BREEM AND THE INDICES OF ENVIRONMENTAL CONDITIONS.] Roczn. Nauk Roln. Ser. B Rybactwo 96 (3): 155-170. 1974. In Polish with English summ. SFA 20(4).

Results of investigation of a relationship between four indices of the fecundity of bream and 11 selected indices of the environmental conditions in lakes. An analysis of the relationship was performed on the basis of coefficients of simple and multiple correlations, and of multiple regression in the set of 11 indices as well as in the set of indices reduced in number. (Auth. Synopsis)

75-000475 Marliave, J. B. (Inst. Anim. Resour. Ecol., Univ. British Columbia, Vancouver, BC V6T 1W5, Canada) SEASONAL SHIFTS IN THE SPAWNING SITE OF A NORTHEAST PACIFIC INTERTIDAL FISH. J. Fish. Res. Board Can. 32 (10): 1687-1691. Oct. 1975. In English with French summ. SFA 20(4).

In Barkley Sound, Vancouver Island, Canada, the spawning of the black prickleback, /Xiphister atropurpureus/, occurs during winter on rocky beaches protected from wave action. However, during spring, spawning occurs on rocky beaches of increasing exposure. This species spawns only under boulders with pebble, small rock, or shell

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substrates. Coincident reduction of wave action and increases in temperature probably cause the seasonal shift in the spawning site of this stichaeid.

75-000476 Phillips, R. W.; Lantz, R. L.; Claire, E. W.; Moring, J. R. (U.S. For. Serv., P.O. Box 3623, Portland, OR 97208) SOME EFFECT OF GRAVEL MIXTURES ON EMERGENCE OF COHO SALMON AND STEELHEAD TROUT FRY. Trans. Am. Fish. Soc. 104 (3): 461-466. July 1975. SFA 20(4).

Eight mixtures of sand and gravel were tested in experimental troughs, to simulate hatching conditions in coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Salmo gairdneri*) redds. Fry were released into perforated, open-ended chambers below the gravel surface. An inverse relationship was found between the quantity of fines and emergent survival. Mean emergent survival for coho salmon ranged from 96 percent in the control mixture to 8 percent in 70 percent sand (less than 3.3 mm diameter). Mean emergent survival for steelhead ranged from 94 percent to 18 percent, respectively. Premature emergence of coho fry was related to higher concentrations of fines. These premature fry were smaller, and retained more yolk than fry emerging at normal times.

75-000477 Slatick, E.; Park, D. L.; Ebel, W. J. (NMFS, 2725 Montlake Blvd. East, Seattle, WA 98112) FURTHER STUDIES REGARDING EFFECTS OF TRANSPORTATION ON SURVIVAL AND HOMING OF SNAKE RIVER CHINOOK SALMON AND STEELHEAD TROUT. NOAA Fish. Bull. 73 (4): 925-931. Oct. 1975. SFA 20(4).

The homing of adult fish, captured during their seaward migration as juveniles and transported downstream (from Ice Harbor Dam to Bonneville Dam), was not reduced by the transport operation. Although numbers of returning adults were small, comparisons of returns of transported fish versus control fish to Ice Harbor Dam, the spawning grounds, and hatcheries in Idaho indicated that they "homed" satisfactorily. No evidence of straying of transported fish was observed in our surveys. (From Auth. Concl.)

75-000478 Vogele, L. E. (U.S. FWS, 113 S. East St., Fayetteville, AR) REPRODUCTION OF SPOTTED BASS, *MICROPTERUS PUNCTULATUS*, IN BULL SHOALS RESERVOIR, ARKANSAS. U.S. Fish Wildl. Serv. Tech. Pap. 84. 21p. 1975. SFA 20(4).

Spotted bass, *Micropterus punctulatus*, were studied in Bull Shoals Reservoir during 1966-71 to determine some of the environmental requirements for successful spawning and to estimate the reproductive potential of the species.

Underwater observations were conducted weekly during the spawning seasons in habitats along steep bluffs and in shallow coves. During two seasons in which water levels were low, nest density was greatest along the bluff; during two high-water seasons, however, the bluff area was not used for spawning. Spawning seasons began as early as 10 April and as late as 27 April in different years, and extended into late May or early June. Nests with fresh eggs were found at water temperatures of 12.8 to 22.8 C. Eggs hatched in about 5 days at 14.4 to 15.6 C; larvae remained in nests for about 8 days at temperatures of 15.6 to 17.2 C. Nest depth was directly correlated with water transparency along the bluff but not in coves. Males defended nests during incubation and larval development, and guarded schools of fry as long as 4 weeks. Mean number of eggs in 21 nests was 5,016 and mean number of larvae in 15 nests was 1,476. Three males are known to have renested after their initial nests were unsuccessful.

Fecundity was estimated by counting the most advanced ova (diameters of ova were multimodal) from a cross section sample of the ovary and

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expanding this quantity by a gravimetric procedure. Fecundity of 27 females ranged from 3,249 to 30,586; it was directly correlated with total length, body weight, and age of fish. Resorption of residual ova began soon after spawning, and regeneration of ova was in progress by October.

75-000479 Wallace, J. H. (Oceanogr. Res. Inst., P.O. Box 736, Durban 4000, South Africa) THE ESTUARINE FISHES OF THE EAST COAST OF SOUTH AFRICA. III. REPRODUCTION. S. Afr. Assoc. Mar. Biol. Res., Invest. Rep. No. 41. 51p. Nov. 1975. Available from: The Librarian, Oceanogr. Res. Inst., P.O. Box 736, Durban 4000, South Africa. SFA 20 (4).

Most species spawn at sea despite the fact that they are adapted to the variable environmental conditions typical of estuaries. It is suggested that this is because the relatively stable marine environment is more suitable for the survival of egg and larval stages. Emigration of adult fish from estuaries is usually related to the need to spawn at sea. Many species migrate into estuaries during the post-spawning and inactive phases of their reproductive cycles. Evidence is presented to show that the spawning grounds of the dominant estuarine species are located inshore and in the vicinity of estuary mouths. Spawning is likely to occur in this environment so as to increase the chances of juveniles migrating into East Coast estuaries, instead of becoming transported to the less favourable South Coast region by the Agulhas Current. Certain small species do spawn in estuaries and seem to have overcome the problems associated with spawning in this environment by developing specialised reproductive mechanisms. The spawning season of the dominant estuarine species is during late autumn, winter and spring (May to November) and it is suggested that this enables juveniles to migrate into estuaries before the summer rainfall season of strong river outflow. The dominant estuarine species have extended spawning seasons lasting 4-8 months. This prolongs the period of juvenile recruitment into estuaries and appears to have a 'buffering' action against failure of recruitment as a result of droughts or unseasonal floods. (From Auth. Summ. and Concl.)

75-000480 Westrheim, S. J. (Fish. Mar. Serv., Pacific Biol. Stn., Nanaimo, BC V9R 5K6, Canada) REPRODUCTION, MATURATION, AND IDENTIFICATION OF LARVAE OF SOME /SEBASTES/ (SCORPAENIDAE) SPECIES IN THE NORTHEAST PACIFIC OCEAN. J. Fish. Res. Board Can. 32 (12): 2399-2411. Dec. 1975. In English with French summ. SFA 20 (4).

Insemination and parturition seasons, maturation, and descriptions of preextrusion larvae were reported for several /Sebastes/ (Scorpaenidae) species (66,760 specimens; 31 species) studied during 1963-73 in the northeast Pacific Ocean, from Oregon (43° N) to the western Gulf of Alaska (170° W). Principal month of insemination was October. Parturition season varied considerably among species--earlier than February for two species, and later than June for five. Within species, parturition season was generally later in the higher latitudes. Maturation of both sexes included an intermediate stage whose minimum duration was 1 yr. Length-maturity relationships were determined for 18 /Sebastes/ species. The size interval in which 50 percent of specimens were mature ranged from less than 17 cm for male /S. saxicola/ to 48 cm for female /S. pinniger/. Identification of preextrusion larvae by conventional morphological criteria was precluded by interspecific similarities and intraspecific differences. Within-area bathymetric variation in gonad development of /S. alutus/ provided additional evidence of subpopulations.

MOVEMENTS, SEASONAL AND DEPTH DISTRIBUTION, ETC.

75-000481 Bowler, B. (Idaho Dep. Fish Game, 2320 Government Way, Coeur d'Alene 83814) FACTORS INFLUENCING GENETIC CONTROL IN LAKEWARD MIGRATIONS OF CUTTHROAT TROUT FRY. Trans. Am. Fish. Soc. 104 (3): 474-482. July 1975. SFA 20(4).

Progeny from inlet-spawning cutthroat trout (*Salmo clarki*) in Yellowstone Lake move downstream and progeny from outlet-spawning adults move upstream to enter the lake to rear. I examined the role of genetic control, rheotactic acclimation (acclimating swim-up fry to water current and no water current), constant and fluctuating water temperatures, and changing water source in directing migrations of Yellowstone Lake fry by testing them in simulated stream channels.

Genetic control influenced upstream and downstream movement of /Inlet/ and /Outlet/ fry, but rheotactic acclimation significantly altered the direction of migration of inlet fry. Fry moved under genetic controls in constant and fluctuating water temperatures and in tests of changing water source, but /Outlet/ fry that were tested in a water source other than that used for incubation and acclimation moved downstream in higher numbers than those tested in the same water source used for incubation and acclimation. Tests of parental influence were inconclusive but some tests yielded migration patterns similar to those of the female parent.

Hatchery operations that include rearing fry in open raceways, exposing them to water current, can alter the behavior of newly emerged fry.

75-000482 Erman, D. C.; Leidy, G. R. (Dep. For. Conserv., Univ. Calif., Berkeley 94720) DOWNSTREAM MOVEMENT OF RAINBOW TROUT FRY IN A TRIBUTARY OF SAGEHEN CREEK, UNDER PERMANENT AND INTERMITTENT FLOW. Trans. Am. Fish. Soc. 104 (3): 467-473. July 1975. SFA 20(4).

Rainbow trout fry spawned in an intermittent stream had a diel periodicity in downstream movement that was highly correlated with discharge. Shortly after fry emerged in mid-July 1973, Kilm Meadow Tributary of Sagehen Creek began to dry up and fry began to move downstream, primarily during the day. After rains, when the water level remained high (5 to 8 liters/s) without diel fluctuations, few fry were captured in the trap.

In 1974 the tributary was permanent and fry exhibited a nocturnal downstream emigration. Many fry remained in the tributary where they were almost the only fish occupants.

75-000483 Gallaway, B. J.; Strawn, K. (LGL Limited-US, Inc., Environ. Res. Assoc., 2301 Texas Ave., Bryan, TX 77801) SEASONAL AND AREAL COMPARISONS OF FISH DIVERSITY INDICES AT A HOT-WATER DISCHARGE IN GALVESTON BAY, TEXAS. Contrib. Mar. Sci. 19: 79-89. Aug. 1975. SFA 20(4).

Trawl and hydrological samples were taken at 11 stations once each month January 1968 through December 1969 in an area of Galveston Bay receiving a discharge of heated water from the P. H. Robinson Generating Station. The stations were grouped by location into three areas: 1) an up-bay control area, 2) the discharge area and 3) a down-bay control area. The data from stations in each of the three areas were pooled and three diversity indices, the Shannon-Weaver index (H'), evenness (J) and species richness (D), were calculated for each monthly sample. Analysis of all indices showed marked seasonal differences. No significant differences in overall diversity (H') or evenness indices were observed between years or areas. The species richness index for 1968 was significantly higher than that for 1969

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and the discharge area had significantly greater species richness than either control area. The greater species richness in the discharge area may have been related to sample size. In the discharge area, all indices declined when mean surface water temperature was above 35C.

75-000484 Johnson, L. (Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB R3T 2N6, Canada) DISTRIBUTION OF FISH SPECIES IN GREAT BEAR LAKE, NORTHWEST TERRITORIES, WITH REFERENCE TO ZOOPLANKTON, BENTHIC INVERTEBRATES, AND ENVIRONMENTAL CONDITIONS. J. Fish. Res. Board Can. 32 (11): 1989-2004. Nov. 1975. In English with French summ. SFA 20(4).

Benthic invertebrates in Great Bear Lake are most highly concentrated in the upper 20 m. Densities between 20 and 100 m are low; below 100 m only *Mysis relicta* and *Myoxocephalus quadricornis* exist at measurable densities. All benthic organisms exhibit a high degree of patchiness.

Lake trout, *Salvelinus namaycush*, and *M. quadricornis* are two species that inhabit the lake at all depths (3-400 m) and temperatures (13.2 C for *M. quadricornis* and 15 C for *S. namaycush*).

Whitefish, *Coregonus clupeaformis*, inhabit only the bays, seldom being caught in water over 20 m deep. The distribution of whitefish is considered to be restricted mainly by the density of benthic organisms.

Three species are confined to the periphery of the lake, *Stizostedion vitreum*, *Lota lota*, and *Catostomus catostomus*. Two species, *Couesius plumbeus* and *Percopsis omiscomaycus*, are present in the headwaters and Great Bear River but have not been able to establish themselves in Great Bear Lake. Extreme oligotrophy is considered to have had the effect of reducing species diversity.

75-000485 Mason, J. C. (Fish. Mar. Serv., Pacific Biol. Stn., Nanaimo, BC V9R 5K6, Canada) SEAWARD MOVEMENT OF JUVENILE FISHES, INCLUDING LUNAR PERIODICITY IN THE MOVEMENT OF COHO SALMON (*ONCORHYNCHUS KISTUCH*) FRY. J. Fish. Res. Board Can. 32 (12): 2542-2547. Dec. 1975. In English with French summ. SFA 20(4).

Following emergence, more than 51,000 coho salmon (*Oncorhynchus kisutch*) fry moved seaward from Lynn Creek. Peaks in movement occurred coincident with the new moon and progressively declined through four lunar cycles although 75 percent of the outmovement took place between early April and the middle of June. Coho smolt migration occurred simultaneously, the run peaking in late May during a period of maximum low tides between sunrise and sunset when the moon was full. Sticklebacks (*Gasterosteus*) moved seaward sporadically throughout the trapping period from April to September but their numbers increases markedly in August due to the appearance of underyearlings. The seaward movement of coho fry and smolts and of sticklebacks showed no apparent relationship to either stream discharge or temperature.

Lunar rhythmicity in movement of coho fry and probable fate of fry are discussed within a framework of behavioral and ecologic concepts pertinent to the species' life history in the juvenile stage and relevant to concern for enhancing coho salmon production.

75-000486 Mense, J. B. (Okla. Dep. Wildl. Conserv., 1416 Planck, Norman 73069) RELATION OF DENSITY TO BROWN TROUT MOVEMENT IN A MICHIGAN STREAM. Trans. Am. Fish. Soc. 104 (4): 688-695. Oct. 1975. SFA 20(4).

Summer mark and recapture experiments were performed on the brown trout (*Salmo trutta*), population of the Pine River, Michigan. Three 427-m sections were divided into seven 61-m stations, and trout over 15 cm in total length from each station were marked distinctively. Even though the population density of brown trout over 15 cm in total length decreased approximately 50 percent from 1968 to 1969, trout movement patterns did not change. Brown trout oriented their movements around the station of original capture in both years. If a positive relationship between movement and population density exists, it exists at densities exceeding 209 trout per hectare.

75-000487 Moore, C. J.; Burton, D. T. (Acad. Nat. Sci. Phila., Benedict Estuarine Res. Lab., Benedict, MD 20612) MOVEMENTS OF STRIPED BASS, *MORONE SAXATILIS*, TAGGED IN MARYLAND WATERS OF CHESAPEAKE BAY. Trans. Am. Fish. Soc. 104 (4): 703-709. Oct. 1975. SFA 20(4).

During the fall of 1972, 1,762 striped bass, *Morone saxatilis* (Walbaum), 28-32 cm in total length, were tagged with Peterson disk tags and released in the open waters of Chesapeake Bay in the vicinity of a nuclear power station off Calvert County, Maryland. A total of 721, or 41 percent, of these fish were recaptured, with the majority being at large more than 30 days. Of these recaptures 629 were taken in the Maryland portion of Chesapeake Bay and tributaries, 43 were taken in the Potomac River estuary, 57 were taken in the Virginia portion of Chesapeake Bay and tributaries, and 6 were taken outside of Chesapeake Bay.

Seasonal recapture locations indicate that (1) the deep water of open Chesapeake Bay serves as an important overwintering area for Chesapeake Bay striped bass; (2) these fish remain active throughout the winter months traveling both north and south with some individuals moving the entire length of the Bay and others moving into various river systems; (3) during the early spring these fish segregate out, presumably into their natal river systems to spawn, both in the Maryland and Virginia portions of the Bay; and (4) after the spring spawning a portion of the population moves out of the Bay to spend the summer months along the Atlantic Coast.

75-000488 Olla, B. L.; Bejda, A. J.; Martin, A. D. (NMFS, Sandy Hook Lab., Highlands, NJ 07732) ACTIVITY, MOVEMENTS, AND FEEDING BEHAVIOR OF THE CUNNER, *TAUTOGOLABRUS ADSPERSUS*, AND COMPARISON OF FOOD HABITS WITH YOUNG TAUTOG, *TAUTOGA ONITIS*, OFF LONG ISLAND, NEW YORK. NOAA Fish. Bull. 73 (4): 895-900. Oct. 1975. SFA 20(4).

Field observations off Long Island, N.Y., using scuba and ultrasonic tracking, showed the cunner, *Tautogolabrus adspersus*, to be active during the day and inactively lying in shelter at night. Fish restricted their movements during the day, remaining within 2 m of the structure providing the nighttime shelter. The fish overwinter within their home territory in a torpid, nonfeeding state. Cunner fed primarily on invertebrates, foraging both benthically and in the water column. Competition between cunner and young tautog, *Tatuoga onitis*, for *Mytilus edulis* was apparent during May-June when it is the major food item for both species. But beginning in July and extending through October, while tautog continued to feed primarily on mussels, cunner shifted to a diet consisting mainly of the isopod, *Idotea baltica*.

75-000489 Pedersen, H. G. (Wash. State Dep. Fish., Univ. Wash., Seattle 98195) MOVEMENTS AND GROWTH OF PETRALE SOLE (*Eopsetta jordani*) TAGGED OFF WASHINGTON AND SOUTHWEST VANCOUVER ISLAND. J. Fish. Res. Board Can. 32 (11): 2169-2177. Nov. 1975. In English with French summ. SFA 20(4).

Tagging studies indicate that spawning groups of petrale sole (*Eopsetta jordani*) from Cape Flattery Spit Deep and Willapa Deep were the most significant contributors to the summer inshore fishery for petrale sole off Washington and Vancouver Island. Spawning groups south of Willapa Deep contributed less than 5 percent to this fishery. The Willapa Deep group was estimated to be at least as large as the Cape Flattery Spit Deep, although the latter supported a much larger winter fishery. Fish tagged during winter on Cape Flattery Spit Deep ranged primarily from Esteban Point south to Quillayute during summer. Ninety-seven percent of the winter recoveries from tag releases in deepwater spawning areas were made in the area of release.

Length composition data suggested that after spawning offshore, adult sole returned to inshore grounds during the summer.

For mature sole, growth parameters estimated from tagged fish agreed with those calculated by other methods of ageing.

75-000490 Richkus, W. A. (Environ. Tech. Cent., Martin Marietta Corp., 1450 S. Rolling Rd., Baltimore, MD 21227) MIGRATORY BEHAVIOR AND GROWTH OF JUVENILE ANADROMOUS ALEWIVES, *Alosa pseudoharengus*, IN A RHODE ISLAND DRAINAGE. Trans. Am. Fish. Soc. 104 (3): 483-493. July 1975. SFA 20(4).

The majority of juvenile alewives (*Alosa pseudoharengus*) migrating seaward from Hamilton Reservoir, North Kingstown, Rhode Island, did so on less than 10 percent of the total days of their period of residence in freshwater during 1970, 1971, and 1972. Extensive migration occurred following increases in pond outflow, abrupt water temperature declines, and/or precipitation. Daily patterns of movement were unimodal, with maximum movement occurring in mid-afternoon. Groups of fish migrating downstream during periods of extensive migration were random portions of the pond population. Growth rates varied in different parts of the drainage system. A model of the behavioral basis for seaward migration of juvenile alewives from ponds and lakes is presented.

75-000491 Thomas, A. E. (U.S. FWS, Fish Farming Exp. Stn., Stuttgart, AR 72160) MIGRATION OF CHINOOK SALMON FRY FROM SIMULATED INCUBATION CHANNELS IN RELATION TO WATER TEMPERATURE, FLOW, AND TURBIDITY. Prog. Fish-Cult. 37 (4): 217-223. Oct. 1975. SFA 20(4).

Daily numbers of fry migrating from the Abernathy incubation channel have greatly increased shortly after periods of heavy rainfall. Conditions in the channel were simulated in a series of troughs in an attempt to isolate the factors triggering fry migration. Chinook salmon (*Oncorhynchus tshawytscha*) fry were subjected to long-term exposure of filtered or unfiltered creek water at two water-flow rates, and to short-term exposure to increased water temperature, water flow, and turbidity. Increased numbers of fry left the troughs after heavy rainfalls even though turbidity was reduced with filters and constant water flows were maintained. No differences in migration patterns occurred between troughs with constant water flows of 36.2 l/min and 72.5 l/min. Introduced stimuli of increased turbidity and water temperature resulted in major increases in numbers of fry leaving the troughs. No substantial increase occurred when water flows were doubled. Migration from a trough receiving all three stimuli was about the same as the total from the three individual troughs.

75-000492 Warden, R. L., Jr.; Lorio, W. J. (TVA, Muscle Shoals, AL 35660) MOVEMENTS OF LARGEMOUTH BASS (*MICROPTERUS SALMOIDES*) IN IMPOUNDED WATERS AS DETERMINED BY UNDERWATER TELEMETRY. Trans. Am. Fish. Soc. 104 (4): 696-702. Oct. 1975. SFA 20(4).

Sixteen sonic-tagged largemouth bass (*Micropterus salmoides*) were released from 4 March 1972 to 14 April 1973 to determine water management practices and environmental factors that may affect fish movement, home range of largemouth bass, and behavior patterns associated with activity within home area. Tags had an average life of 13.8 days. They were implanted in the body cavity and seemed to have no effect on the movements of the bass. A total of 570 hours of tracking showed water temperature to be the only parameter that related to increases or decreases in movement. Diurnal movement was prevalent in the spring and fall. Nocturnal movement increased as water temperature approached summer highs. Fish were most active in March and September and least active in December and January. Home ranges differed with seasonal water temperature changes but never exceeded 100 m. Behavior patterns associated with activity within home range consisted of movements from deep to shallow water.

FOODS AND FEEDING

75-000493 Archibald, C. P. (Dep. Zool., Univ. Manitoba, Winnipeg, MB, Canada) EXPERIMENTAL OBSERVATIONS ON THE EFFECTS OF PREDATION BY GOLDFISH (*CARASSIUS AURATUS*) ON THE ZOOPLANKTON OF A SMALL SALINE LAKE. J. Fish. Res. Board Can. 32 (9): 1589-1594. Sept. 1975. In English with French summ. SFA 20(4).

The short-term effects of various intensities of fish predation of zooplankton communities were examined. Field studies indicated that fish predation was, as expected, size-selective: in the presence of fish, size distributions of the principal prey, *Daphnia pulex*, were skewed toward the smaller size-classes and the minimum size of egg-bearing *D. pulex* was also smaller. Fecundity of *Diaptomus ashlandi*, and probably also of *Daphnia pulex*, was greater with fish present. This caused the abundance of these two dominant species to increase initially with increasing predation. Subsequently, the species declined at higher predation levels in order of their interest to fish, with large *D. pulex* (≥ 1.35 mm) declining before small *D. pulex* (less than 1.35 mm) and both groups doing so at lower predation levels than *Diaptomus ashlandi*.

75-000494 Baily, J. E.; Wing, B. L.; Mattson, C. R. (NMFS, P.O. Box 155, Auke Bay, AK 99821) ZOOPLANKTON ABUNDANCE AND FEEDING HABITS OF FRY OF PINK SALMON, *ONCORHYNCHUS GORBUSCHA*, AND CHUM SALMON, *ONCORHYNCHUS KETA*, IN TRAITORS COVE, ALASKA, WITH SPECULATIONS ON THE CARRYING CAPACITY OF THE AREA. NOAA Fish. Bull. 73 (4): 846-861. Oct. 1975. SFA 20(4).

Juvenile pink salmon, *Oncorhynchus gorbuscha*, and chum salmon, *O. keta*, 28 to 56 mm long (fork length) from Traitors River in southeastern Alaska, fed little in freshwater but fed heavily in the estuary, mainly on pelagic zooplankters. Fry did not feed on cloudy moonless nights. The rate of evacuation of pink salmon stomachs ranged from 6 h at 12.8°C to 16 h at 8.5°C. The abundance of zooplankton ranged from 9 to 154 organisms per liter and quantitatively did not change noticeably while fry were in the estuary. In 1964, 1965, and 1966, the estimated numbers of fry in Traitors Cove was 7, 1 and 4 million, respectively. An attempt was made to estimate the carrying capacity of Traitors Cove, using food consumption and evacuation rates

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in conjunction with estimates of standing crop of zooplankton. It was concluded that 50 to 100 million additional fry from hatcheries would probably exceed the carrying capacity of the estuary.

75-000495 Cherry, D. S.; Guthrie, R. K. (Dep. Biol., VPI & SU, Blacksburg, VA 24061) SIGNIFICANCE OF DETRITUS OR DETRITUS-ASSOCIATED INVERTEBRATES TO FISH PRODUCTION IN A NEW IMPOUNDMENT. J. Fish. Res. Board Can. 32 (10): 1799-1804. Oct. 1975. In English with French summ. SFA 20(4).

During early stages of succession in a new impoundment, fish species that could assimilate the readily available food resources, i.e. carp (*Cyprinus carpio*) and flat bullhead (*Ictalurus platycephalus*) were initially favored in numbers and weight. Detrital feeders or omnivores represented by carp and the flat bullhead comprised a majority of the numbers (56 percent) and weight (65 percent) of the 25 species captured during a 2-yr period. Numbers of the major fish groups captured decreased from 1971 to 1972, while the weight per species increased.

On a volumetric basis, detritus and detritus-associated invertebrates (coleopterans and dipterans), were the major food items consumed by carp and catfish. Relative abundance of animal food items, in terms of frequency of occurrence and percentage of stomach contents, was greater at warmer water temperatures. In comparison to other species, catfish contained the greatest diversity of food items during warmer months and consumed larger quantities of detritus in the winter. Fish groups that constituted a smaller biomass, such as centrarchids, were generally insectivorous or fed upon cladocerans and copepods, while adult basses (*Micropterus salmoides* and *M. coosae*) and chain pickerel (*Esox niger*) were piscivorous.

75-000496 Giussani, G. PLANCTOPAGIA SELETTIVA DEL COREGONE "BONDELLA" (*COREGONUS*/ SP.) DEL LAGO MAGGIORE. [PLANKTON SELECTION OF THE WHITEFISH, BONDELLA, (*COREGONUS*/ SP.) OF LAGO MAGGIORE.] Mem. Ist. Ital. Idrobiol. 31: 181-203. 1974. In Italian with English summ. SFA 20(4).

The population of zooplankton and the gut contents of the planktophagous white fish "bondella" (*Coregonus*/ sp., family *Salmonidae*, sub-family *Coregoninae*) were studied and compared over one year. This analysis demonstrated marked food preferences by this planktivore fish: copepods, in particular diaptomids, are excluded from the diet whereas the predatory cladocerans *Bythotrephes longimanus* and *Leptodora kindtii* are strongly selected; in addition there is a heavy predation on those adult *Daphnia hyalina* with lengths greater than 1500 μ . In general, the appearance of a larger zooplankton species allows the *Coregonus*/ to shift from its previous food. Thus the appearance of *D. hyalina* in late spring is followed by the disappearance of cyclopoid copepods from the stomachs of the white fish; the appearance of *B. longimanus* and *L. kindtii* in early summer is accompanied by a shift away from *Daphnia*/ and to these still larger Cladocerans. Since the larger zooplankton are also those more capable of movement, it is possible that these two characteristics cause these animals to stand out against a background of smaller, less obvious organisms. This in turn subjects these zooplankton to greater attacks by visual predators such as *Coregonus*/.

The consequences of such predation are both interesting and difficult to interpret. The trophic relationships may be very complex; for example, adult *D. hyalina* are eaten by *Coregonus*/, but the juveniles by *Bythotrephes longimanus* and *Leptodora kindtii* which themselves suffer heavy predation by *Coregonus*/. These observations suggest that the situation requires more detailed study, perhaps of

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the population dynamics of the various components. (Auth. Summ.)

75-000497 Hopkins, T. L.; Baird, R. C. (Dep. Mar. Sci., Univ. South Fla., St. Petersburg 33701) NET FEEDING IN MESOPELAGIC FISHES. NOAA Fish. Bull. 73 (4): 908-914. Oct. 1975. SFA 20(4).

In an investigation of net feeding, 11 species of fish (5 gonostomatids, 6 myctophids) captured in a double-net Tucker trawl were examined. Stomach contents of fish retained by a coarse mesh "fish-catcher" in one net were compared to contents of fish which had accumulated with plankton in the cod end of the adjacent net. Out of 19 species-collection pairs (700 fish), there were significant (P less than 0.05) differences in number of prey items in stomachs of only three species in five collections. Two pairs, fish from the cod end and in three pairs, those from the "fish-catcher," contained significantly more prey than fish from the adjacent trawl. There were little or no significant differences between trawls in number of fish scales, prey diversity, or prey size. These results suggest that literature data on diet of mesopelagic fishes is not heavily biased from net feeding and that existing collections can be used for feeding investigations.

75-000498 Klarberg, D. P.; Benson, A. (Dep. Biol., VPI & SU, Blacksburg, VA 24061) FOOD HABITS OF *ICTALURUS NEBULOSUS* IN ACID POLLUTED WATER OF NORTHERN WEST VIRGINIA. Trans. Am. Fish. Soc. 104 (3): 541-547. July 1975. SFA 20(4).

A qualitative and quantitative investigation of the food habits of the brown bullhead, *Ictalurus nebulosus* (LeSueur), was conducted between June and September, 1968, in the acid-polluted Monongahela River, West Virginia, and in Doe Pond, a small relatively pollution-free subimpoundment of the Tygart River Reservoir, West Virginia.

Oligochaetes were the most important invertebrate food source in the Monongahela River, whereas chironomid larvae were the most important invertebrates consumed at Doe Pond. Also consumed were significant quantities of detritus and algae at Doe Pond, and sewage at outfall-associated sections of the Monongahela River. No qualitative difference in food habits was noted between different size groups of fish in either acid or non-acid situations. The bottom fauna of the Monongahela River were unevenly distributed; the most abundant organisms were oligochaetes, with chironomids ranked second. An Ivlev Electivity Index of -0.06 was obtained for oligochaetes, indicating random feeding, and a value of $+0.55$ was derived for chironomids, indicating selection for them.

The brown bullhead is able to meet its nutritional requirements with detritus, sewage, and acid-tolerant invertebrates.

75-000499 Naiman, R. J. (Pacific Biol. Stn., Fish. Mar. Serv., Nanaimo, BC V9R 5K6, Canada) FOOD HABITS OF THE AMARGOSA PUPFISH IN A THERMAL STREAM. Trans. Am. Fish. Soc. 104 (3): 536-538. July 1975. SFA 20(4).

Food habits of an Amargosa pupfish (*Cyprinodon nevadensis amargosae*) population inhabiting a thermal stream were examined at monthly intervals from January 1972 to April 1973. Little variation in foods eaten during the year was observed in the 218 specimens examined. The diet was almost entirely a mixture of blue-green algae and detritus. Invertebrates were only a minor component due to their scarcity in the stream. The smallest fishes consumed some invertebrates but this habit changed as the relative length of the digestive tract rapidly increased.

75-000500 Patten, B. G. (NMFS, 2725 Montlake Blvd. East, Seattle, WA 98112) COMPARATIVE VULNERABILITY OF FRY OF PACIFIC SALMON AND STEELHEAD TROUT TO PREDATION BY TORRENT SCULPIN IN STREAM AQUARIA. NOAA Fish. Bull. 73 (4): 931-934. Oct. 1975. SFA 20(4).

Aquarium studies showed variation between rates of predation on a prey species, size of prey species, and on temperature and length of daylight during testing. Predation by torrent sculpin was least on coho and chinook salmon, intermediate on sockeye salmon and steelhead trout, while practically complete on pink and chum salmon. Chi-square analysis showed significant differences between all species except for 2 of the 10 combinations tested: sockeye salmon-steelhead trout and pink-chum salmon. The number of survivors per test varied considerably for the chinook salmon and steelhead trout. (RS)

75-000501 Pope, G. F.; Carter, J. C. H. (Beak Consult. Ltd., Rexdale, ON M9W 1R6, Canada) CRUSTACEAN PLANKTON COMMUNITIES OF THE MATAMEK RIVER SYSTEM AND THEIR VARIATION WITH PREDATION. J. Fish. Res. Board Can. 32 (12): 2530-2535. Dec. 1975. In English with French summ. SFA 20(4).

The crustacean plankton communities of lakes with fish planktivores and low densities of /Chaoborus/ larvae contained greater numbers of noncyclopoid crustacean predators but lower numbers of the larger herbivores. Lakes with brook trout (/Salvelinus fontinalis/) only and low densities of /Chaoborus/ larvae, had plankton communities whose biomasses were dominated by the larger herbivores. The communities of lakes with no fish and high densities of larvae were dominated by the smaller herbivores, although the larger species were present in some. The noncyclopoid, crustacean predators were absent from almost all of these lakes.

75-000502 Prince, E. D. (Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA 24061) PINNIXID CRABS IN THE DIET OF YOUNG-OF-THE-YEAR COPPER ROCKFISH (/SEBASTES CAURINUS/). Trans. Am. Fish. Soc. 104 (3): 539-540. July 1975. SFA 20(4).

/Pinnixa faba/ and /Pinnixa littoralis/ ranked third and seventh, respectively, in the list of major food items in the diet of young-of-the-year copper rockfish from an artificial reef in South Humboldt Bay, California. Previously, /P. faba/ and /P. littoralis/ have been described as being primarily internal commensals of marine pelecypods and as such were not considered an important food or finfish.

75-000503 Vinyard, G. L.; O'Brien, W. J. (Dep. Syst. Ecol., Univ. Kans., Lawrence 66045) DORSAL LIGHT RESPONSE AS AN INDEX OF PREY PREFERENCE IN BLUEGILL (/LEPOMIS MACROCHIRUS/). J. Fish. Res. Board Can. 32 (10): 1860-1863. Oct. 1975. In English with French summ. SFA 20(4).

An apparatus utilizing the variation in the dorsal light response of sight-feeding planktivorous fish when exposed to prey of various lengths, was used to measure the predator's interest in particular prey. Comparison of results with actual selection of prey by fish under experimental conditions confirms the importance of prey length in determining the preference of these predators.

AGE AND GROWTH

75-000504 Aguayo H., M. ESTUDIO DE LA EDAD Y EL CRECIMIENTO DE LA MERLUZA DE COLA (MACRURONUS MAGELLANICUS, LONNBERG, 1907). [AGE AND GROWTH STUDY OF MERLUZA DE COLA (/MACRURONUS MAGELLANICUS/, LONNBERG, 1907).] Ser. Invest. Pesq., Inst. Fom. Pesq. 19. iii + 41p. 1974. In Spanish with English summ. SFA 20(4).

Preliminary research on age and growth of merluza de cola (/Macruronus magellanicus/) was made. The analyzed material belongs to a sample of 384 otoliths, collected in January 1972.

A high correlation was found between the increase in length of the fish and the otolith. In this relation, males and females did not show significant differences.

The number of hyaline rings read was 8, which were seen very neatly. These rings were assimilated into annual age groups.

The growth in length of the fish, according to the Von Bertalanffy growth equation, is $l(t) = 66.8 [1 - e^{-0.35984(t + 0.070851)}]$ and the corresponding equation to the growth in weight, is $W(t) = 804.1 [1 - e^{-0.35984(t + 0.070851)}]^3$.

According to Taylor's concept the limit age for the merluza de cola or the required time to obtain 95 percent of the asymptotic length is 8.3 years.

The instantaneous coefficient of natural mortality according to Taylor's expression, is of 0.361, which corresponds to an annual rate of relative total mortality of 30.2 percent.

75-000505 Brazo, D. C.; Tack, P. I.; Liston, C. R. (Dep. Fish. Wildl., Mich. State Univ., South Lakeshore Dr., Ludington 49431) AGE, GROWTH, AND FECUNDITY OF YELLOW PERCH, /PERCA FLAVESCENS/, IN LAKE MICHIGAN NEAR LUDINGTON, MICHIGAN. Tran. Am. Fish. Soc. 104 (4): 726-730. Oct. 1975. SFA 20(4).

Yellow perch were studied as a portion of a total environmental baseline study in 1972 before operation of a new pumped storage power plant on the eastern shore of Lake Michigan near Ludington. Of 1,546 perch taken by gill nets, age III (1969 year class) and IV fish contributed 40.1 percent and 27.4 percent of the total number, with male fish being taken much more frequently than females in all age classes during spring sampling. Comparative growth and length-weight data indicated that the perch were generally growing to larger sizes than those reported previously from the Great Lakes. Most fish older than age I were sexually mature and spawned in shallow littoral waters from mid-May to late June. Mature fish spent the summer in the littoral zone and moved to deeper water by late fall. The ratio of ovary weight to body weight was 20-25 percent before spawning, declined sharply, and increased again in fall. Ninety-six female fish examined for fecundity had a range of 10,654 to 157,594 eggs, and in general, because of the larger sizes of the fish, had greater fecundity than previously reported for other yellow perch. Regression equations were developed for fecundity vs. length (logarithmic), weight (linear), ovarian weight (logarithmic), and age (semi-logarithmic).

75-000506 Campbell, G.; Collins, R. A. (Calif. Dep. Fish Game, Tiburon 94920) THE AGE AND GROWTH OF THE PACIFIC BONITO, /SARDA CHILIENSIS/, IN THE EASTERN NORTH PACIFIC. Calif. Fish. Game. 61 (4): 181-200. Oct. 1975. SFA 20(4).

An age and growth study of the Pacific bonito, /Sarda chiliensis/, was conducted between 1968 and 1973. Otoliths were used to establish the ages of over 3,000 bonito, and the results verified by length frequency samples, a tag and recapture experiment, and back-calculation of mean length at each age. The results show that bonito grow rapidly during their first 3 years of life, with much slower growth from 3 to 6 years old. The mean length of each age group in the fishery is: age I-51.5 cm (20.3 inches), age II-63.3 cm (24.9 inches), age III-69.5 cm (27.4 inches), age IV-72.9 cm (28.7 inches), age V-74.8 cm (29.4 inches), and age VI-75.7 cm (29.8 inches).

75-000507 Cech, J. J., Jr.; Wohlschlag, D. E. (Dep. Anim. Physiol., Univ. Calif., Davis 95616) SUMMER GROWTH DEPRESSION IN THE STRIPED MULLET, /MUGIL CEPHALUS/ L. Contrib. Mar. Sci. 19: 91-100. Aug. 1975. SFA 20(4).

Growth rates by scale analysis of /Mugil cephalus/ taken from south Texas coastal waters throughout one year showed two major periods of slow growth. The period of slowest growth, followed by annulus formation, occurred during the colder late autumn and winter months. Another major growth depression occurred during the summer when food availability to the mullet should be maximal. Optimal growth rates for Age I and older fish were in spring and briefly in early autumn. Annual growth increments, however, agree well with those for other published Gulf of Mexico mullet studies. Females appear to be slightly, but not significantly, larger and to have somewhat better survival rates. The summer growth rate depression coincides with observations of pronounced summer depression of active and routine respiratory rates observed in earlier studies. This coincidence implies that there may be unknown summertime changes in food assimilation and in biochemical metabolic pathways. The summer growth rate depression would have significant effects on assessments of biological production rates compared to similar assessments conventionally based on yearly increments.

75-000508 Griffith, J. S. (Environ. Sci. Div., Oak Ridge Natl. Lab., Oak Ridge, TN 37830) ANNULUS FORMATION AND GROWTH OF TIGERFISH, /HYDROCYNUS VITTATUS/, IN LAKE BANGWEULU, ZAMBIA. Trans. Am. Fish. Soc. 104 (3): 499-505. July 1975. SFA 20(4).

The validity of scale analysis for aging tigerfish, /Hydrocynus vittatus/ Castelnau, was assessed by examining the timing and cause of check formation on scales from fish collected in Lake Bangweulu, Zambia. Discontinuities in circuli that appeared to be valid annuli formed on all scales in September when water temperature was rising rapidly after dropping to 18 C. Spawning checks formed on scales of some fish in January. Male and female tigerfish grew at similar rates. Some females reached an age of 11 years but male tigerfish, which matured one and sometimes two years earlier, seldom lived longer than 4 years.

75-000509 Magin, E.; Fradette, C. (Dep. Sci. Biol., Univ. Montreal, Montreal, PQ, Canada) CROISSANCE DE LA BARBUE (/ICTALURUS PUNCTATUS/) DU FLEUVE SAINT-LAURENT PRES DE QUEBEC. [GROWTH OF THE CHANNEL CATFISH (/ICTALURUS PUNCTATUS/), IN THE ST. LAWRENCE RIVER NEAR QUEBEC.] J. Fish. Res. Board Can. 32 (10): 1867-1870. Oct. 1975. In French with English summ. SFA 20(4),

Thin sections were made on the spiny rays of pectoral and dorsal fins of 28 channel catfish (/Ictalurus punctatus/) from the St. Lawrence River near Quebec City. Age determinations on these sections and the results of previous taggings gave the following length and weight growth patterns for these individuals: 200 mm and 65 g at age 3, 270 mm and 165 g at age 5, 330 mm and 310 g at age 7, 400 mm and 572 g at age 10, 530 mm and 1236 g at age 20.

75-000510 Marciak, Z. (Inst. Rybactwa Srodladowego, Olsztyn-Kortowo, Poland) CHARAKTERYSTYKA WZROSTU LESZCZA--/ABRAMIS BRAMA/ (LINNAEUS, 1758) W JEZIORACH NA TERENIE POLSKI. [GROWTH CHARACTERISTICS OF BREAM--/ABRAMIS BRAMA/ (LINNAEUS, 1758) FROM POLISH LAKES.] Roczn. Nauk Roln. Ser. H Rybactwo 96 (3): 75-95. 1974. In Polish with English summ. SFA 20(4).

Results of investigations on growth of bream originating from 682 lakes are given. It was found out that the curve of individual growth in weight of the species was S-shaped. The type of growth, character of its variability and bream condition were found to be dependent on a limnological type of a lake. (Auth. Synopsis)

75-000511 Messieh, S. N. (Fish. Mar. Serv., Biol. Stn., St. Andrews, NB, Canada) GROWTH OF THE OTOLITHS OF YOUNG HERRING IN THE BAY OF FUNDY. Trans. Am. Fish. Soc. 104 (4): 770-774. Oct. 1975. SFA 20(4),

Otoliths of 217 young herring (/Clupea harengus harengus/ L.) of lengths (total) 32-118 mm collected from Passamaquoddy Bay were examined for their development and growth. The relationship between otolith lengths (Y) and fish lengths (X) was described by a linear equation $Y = -0.468 + 0.0247X$. Within the size range examined, two otolith growth stanzas were shown and expressed by the equation $Y = -0.788 + 0.0296X$ for fish less than 75mm, and $Y = 0.333 + 0.0155X$ for fish ranging 75-118 mm in total length.

A hyaline ring around the nucleus of unknown origin and different from the winter ring, was observed in some otoliths.

75-000512 Moreau, J. (Ec. Natl. Super. Agron., Tananarive (Madagascar). ESSAI D'INTERPRETATION DES ANNULI OBSERVES SUR LES ECAILLES DE /TILAPIA NILOTICA/ ET /TILAPIA RENDALLI/ DES LACS DES HAUTS PLATEAUX MALGACHES. [INTERPRETATION TRIAL OF ANNULI OBSERVED ON SCALES OF /TILAPIS NILOTICA/ AND /TILAPIA RENDALLI/ OF THE LAKES OF MALAGASY HIGHLANDS.] Ann. Hydrobiol. 5 (2): 83-93. 1974. In French with English summ. SFA 20(4).

Ring formations are observed on scales of /T. nilotica/ and /T. rendalli/ in the lake Itasy and the lake of Mantasoa, on Malagasy Highlands. There is a close relationship between the number of these rings and the standard length of fish. The suitability of using these rings for age determining methods in these /Tilapia/ is discussed; the hypothesis of annual ring formation because of a stop of growth in the scales during the cold season is probably right.

75-000513 Nelson, W. R. (U.S. FWS, P.O. Box 698, Pierre, SD 57501) AGE, GROWTH, AND MATURITY OF THIRTEEN SPECIES OF FISH FROM LAKE OAHE DURING THE EARLY YEARS OF IMPOUNDMENT, 1963-68. U.S. Fish Wildl. Serv. Tech. Pap. 77. 29p. 1974. SFA 20(4).

The body-scale relation, calculated length, length-weight relation, age at maturity, and sex ratio of 13 major species collected in Lake Oahe from 1963 to 1968 with trap nets and bottom trawls are described. Eight species grew at a faster rate than has been recorded in other Missouri River reservoirs: goldeye (*Hiodon alosoides*), bigmouth buffalo (*Ictiobus cyprinellus*), smallmouth buffalo (*Ictiobus bubalus*), white bass (*Morone chrysops*), black crappie (*Pomoxis nigromaculatus*), white crappie (*Pomoxis annularis*), walleye (*Stizostedion vitreum vitreum*), and freshwater drum (*Aplodinotus grunniens*). Four species grow at rates similar to those recorded from other Missouri River reservoirs: carp (*Cyprinus carpio*), yellow perch (*Perca flavescens*), northern pike (*Esox lucius*), and sauger (*Stizostedion canadense*). One species--river carpsucker (*Carpiodes carpio*)--grew slower than in other waters. Growth generally was excellent for all major species in the early years of impoundment (1959-62) but then declined. Species showing the greatest decline in growth from 1962 to 1967 were goldeye, bigmouth buffalo, sauger, walleye, northern pike, and freshwater drum. As growth rate decreased, age at sexual maturity increased for northern pike, carp, river carpsucker, bigmouth buffalo, and freshwater drum.

Although inundation of new lands was associated with rapid growth of fishes in the early years of impoundment, water level fluctuations during the growing season had no discernible effect on growth rate. Increased average reservoir depth, which decreased the amount of littoral area, was associated with decreased fish growth.

75-000514 Ney, J. J.; Smith, L. L., Jr. (Wis. Elec. Power Co., 231 W. Michigan Ave., Milwaukee 53201) FIRST-YEAR GROWTH OF THE YELLOW PERCH, *PERCA FLAVESCENS*, IN THE RED LAKES, MINNESOTA. Trans. Am. Fish. Soc. 104 (4): 718-725. Oct. 1975. SFA 20(4).

First-year growth of the yellow perch, *Perca flavescens* (Mitchill), was determined from 28,241 young-of-the-year fish collected in the Red Lakes during the summer (1 July-20 August) in 15 seasons and on back calculations from I-annulus fish of the same year classes. Sexes did not differ in growth rate. Geographic variations in first-season growth occurred in 2 years but were not reflected at I-annulus. A consistent seasonal growth pattern in all years was linear through the summer sampling period. Growth rate after 20 August gradually declined and became nearly asymptotic by the end of the season. Growth during midsummer varied widely in different seasons, but length at I-annulus was relatively uniform (71-79 mm) for most years as the result of apparent growth compensation. Negative correlations of length on 1 July with mid-summer rate of growth and, consequently, with I-annulus length were noted. Although high summer water temperature appeared to exert a positive influence on growth, it did not obscure the compensatory phenomenon. Growth compensation is probably not affected by predation, but may be related to interaction of perch size and food availability.

75-000515 Noble, R. L. (Dep. Wildl. Fish. Sci., Texas A&M Univ., College Station 77843) GROWTH OF YOUNG YELLOW PERCH (/PERCA FLAVESCENS/) IN RELATION TO ZOOPLANKTON POPULATIONS. Trans. Am. Fish. Soc. 104 (4): 731-741. Oct. 1975. SFA 20(4).

A study to determine the relation of zooplankton abundance to growth of young yellow perch was conducted in Oneida Lake, New York, during late summer of 1968 to 1971. /Daphnia/ species were the principal components of the zooplankton and fish stomachs. Annual variations in consumption and growth by young perch were closely correlated with abundance of /Daphnia/. The total daily consumption of /Daphnia pulex/ by the young perch approached 17 percent of the standing crop when young perch were most abundant. The vertical distribution of /D. pulex/ may increase its vulnerability to predation by young perch. Although predation by the perch population may modify /Daphnia/ populations, qualitative and quantitative variations in the zooplankton occur independently of perch predation and control the growth rates of young perch.

75-000516 Page, J. W.; Andrews, J. W. (P.O. Box 13687, Savannah, GA 31406) EFFECTS OF LIGHT INTENSITY AND PHOTOPERIOD ON GROWTH OF NORMALLY PIGMENTED AND ALBINO CHANNEL CATFISH. Prog. Fish-Cult. 37 (3): 121-122. July 1975. SFA 20(4).

Albino and normally pigmented channel catfish (/Ictalurus punctatus/) fingerlings were reared under two light intensities (7 ft-c and 260 ft-c) and three photoperiods (24 h of darkness, 24 h light, and 12 h darkness plus 12 h light). No differences in growth, food intake, or food conversion were obtained under the experimental conditions. Since differences in growth between albino and normal catfish were not significant, the absence of skin pigment apparently has no influence on growth under varied light conditions.

75-000517 Piper, R. G.; Blumberg, J. L.; Holway, J. E. (U.S. FWS, Fish Cult. Dev. Cent., Bozeman, MT 59715) LENGTH-WEIGHT RELATIONSHIPS IN SOME SALMONID FISHES. Prog. Fish-Cult. 37 (4): 181-184. Oct. 1975. SFA 20(4).

Length increase has been used as a measure of growth for salmonid fishes in National Fish Hatcheries for several years. Fish lengths used in reporting growth data are obtained from length-weight tables based on average condition factors for several species of salmonids.

A comparison was made of condition factors of westslope cutthroat trout (/Salmo clarki/), steelhead (/S. gairdneri/), spring and fall chinook salmon (/Oncorhynchus tshawytscha/), coho salmon (/O. kisutch/) and rainbow trout (/S. gairdneri/).

Steelhead trout length-weight tables can be satisfactorily used with westslope cutthroat trout. There was no significant difference in the condition factor of spring and fall chinook salmon. Diet and water temperature fluctuation have a significant effect on condition factor. If extreme environmental conditions are encountered, a comparison should be made with established length-weight tables to determine if they are applicable. This would be true of wild fish, with their highly variable environment.

75-000518 Priegel, G. R. (Wis. Dep. Nat. Resour., Madison 53711) AGE AND GROWTH OF THE YELLOW BASS IN LAKE POYGAN, WISCONSIN. Trans. Am. Fish. Soc. 104 (3): 513-515. July 1975. SFA 20(4).

Yellow bass age and growth data were obtained from 202 fish collected in Lake Poygan, Wisconsin, a 5,707-hectare widening of the Wolf River, during October, 1963 and winter of 1963-64. The fish length-scale length relationship was $L = 15 + 1.529 (R)$. No significant difference in growth between sexes was found. The growth of Lake Poygan yellow bass was greater than that reported from most areas. All fish were mature at age-group III. The length-weight relationship was $\log W = -4.0289 + 2.7000 \log L$, where W = weight in g and L = total length in mm.

75-000519 Serns, S. L.; Strawn, K. (Wis. Dep. Nat. Resour., Box 440, Woodruff 54568) AGE AND GROWTH OF BLUEGILL, /LEPOMIS MACROCHIRUS/, IN TWO HEATED TEXAS RESERVOIRS. Trans. Am. Fish. Soc. 104 (3): 506-512. July 1975. SFA 20(4).

The method of ageing bluegills by their scales was validated for two Texas reservoirs. Annulus formation occurred from January through July (peak February-April) in Lake Bastrop and from January to June (Peak in March and April) on Lake Nasworthy. Female bluegills grew faster than males in both lakes. Little or no growth occurred from October-November through February. Growth of bluegills in Lakes Bastrop and Nasworthy was above average for the first two years when compared to the growth of bluegills in other lakes reported in the literature. The length-weight regression equations for bluegills from Lake Bastrop and Lake Nasworthy were: $\log W = -4.46319 + 3.01844 \log L$ and $\log W = -4.64744 + 3.13263 \log L$, respectively.

75-000520 Shaw, H. M.; Saunders, R. L.; Hall, H. C. (32 Bulkara Rd., Bellevue Hill, 2023 N.S.W., Australia) ENVIRONMENTAL SALINITY: ITS FAILURE TO INFLUENCE GROWTH OF ATLANTIC SALMON (/SALMO SALAR/) PARR. J. Fish. Res. Board Can. 32 (10): 1821-1824. Oct. 1975. In English with French summ. SFA 20(4).

Growth of Atlantic salmon (/Salmo salar/) parr was studied at environmental salinities of 0.1, 10, and 20 ‰ in relation to daily rations of 0, 1.0, 1.5, 2.2, and 2.9 percent of dry body weight. Instantaneous growth rates and food conversion efficiencies for fish in each salinity were similar. Maintenance ration was slightly more in 20 ‰ than in either the salinity approximately isosmotic with blood (10 percent) or in fresh water (0.1 percent).

75-000521 Spreafico, E.; Berg, A.; Grimaldi, E. ACCRESCIMENTO E FECONDITA DEL COREGONE BONDELLA (/COREGONUS/ SP.) CONSIDERATI IN RAPPORTO ALLE MODIFICAZIONI TROFICHE DEL LAGO MAGGIORE. [GROWTH AND FECUNDITY OF THE WHITEFISH BONDELLA (/COREGONUS/ SP.) CONSIDERED IN RELATION TO EUTROPHICATION OF LAGO MAGGIORE.] Mem. Ist. Ital. Idrobiol. 31: 205-220. 1974. In Italian with English summ. SFA 20(4).

Data concerning growth rate, condition, fecundity, and egg characteristics of the coregonine "bondella" (/Coregonus/ sp.) living in Lago Maggiore have been collected in 1972 and compared with the results of a study made by Berg and Grimaldi in 1962-1964. General data on linear growth in the two periods are reported in Table 2. Size attained by similar age classes seems almost unchanged and seasonal growth curves show the same trend (Fig. 2). On the contrary, condition factor has clearly decreased from 1962-1964, also showing a more sharp pre-reproductive decline in females (Fig. 3). Still more obvious changes refer to fecundity, which fell from 55,000 to 44,000 eggs/kg fish weight (Table 3).

75-000521 CONTINUED

On the whole, the metabolic processes of the coregonines do not apparently reflect the rapid eutrophication which has been occurring in Lago Maggiore during the last years. Increasing intra- and interspecific competition are likely to have counterbalanced the increase in food resources connected with eutrophication. In fact, after its recent introduction into Lago Maggiore (1950), the coregonine "bondella" increased very rapidly. After the sudden collapse of the population in 1972 interspecific competition by bleak (/Alburnus albidus/) and other zooplanktophagous fish probably played the main role. (Auth. Summ.)

75-000522 Weber, D. D.; Shippen, H. H. (NMFS, 2725 Montlake Blvd. East, Seattle, WA 98112) AGE-LENGTH-WEIGHT AND DISTRIBUTION OF ALASKA PLAICE, ROCK SOLE, AND YELLOWFIN SOLE COLLECTED FROM THE SOUTHEASTERN BERING SEA IN 1961. NOAA Fish Bull. 73 (4): 919-924. Oct. 1975. SFA 20(4).

GEOGRAPHICAL DISTRIBUTION, FISH SURVEYS, ETC.

75-000523 Bass, A. J.; D'Aubrey, J. D.; Kistnasamy, N. (Oceanogr. Res. Inst., P.O. Box 736, Durban 4000, South Africa). SHARKS OF THE EAST COAST OF SOUTHERN AFRICA. V. THE FAMILIES HEXANCHIDAE, CHLAMYDOSELACHIDAE, HETERODONTIDAE, PRISTIOPHORIDAE AND SQUATINIDAE. S. Afr. Assoc. Mar. Biol. Res., Invest. Rep. No. 43. 50p. Dec. 1975. Available from: The Librarian, Oceanogr. Res. Inst., P.O. Box 736, Durban 4000, South Africa. SFA 20(4).

75-000524 Berg, R. E.; Doepke, P. A.; Hannuksela, P. R. (Dep. Biol., North Mich.; Univ., Marquette 49855) FIRST OCCURRENCE OF THE BROOK SILVERSIDE, /LABIDESTHES SICCULUS/, IN A TRIBUTARY OF LAKE SUPERIOR. J. Fish. Res. Board Can. 32 (12): 2541-2542. Dec. 1975. In English with French Summ. SFA 20(4).

On June 4, 1974, three brook silversides, /Labidesthes sicculus/, were collected by electrofishing near the mouth of the Dead River, a tributary of Lake Superior at Marquette, Michigan. This is the first record of the species in the Lake Superior watershed and it may be that the species has only recently established itself in the area.

75-000525 Eskinazi de Oliveira, A. M. (Lab. Cienc. Mar., Univ. Fed. Ceara, Fortaleza, Ceara, Brazil) ICTIOFAUNA DAS AGUAS ESTUARINAS DO RIO PARNAIBA (BRASIL). [ICHTHYOFAUNA OF THE ESTUARINE WATERS OF THE PARNAIBA RIVER (BRAZIL).] Arq. Cienc. Mar 14 (1): 41-45. June 1974. In Portuguese with English summ. SFA 20(4).

The present paper is a contribution to the knowledge of the ichthyofauna of the estuarine waters of the Parnaiba River (Brazil).

The ichthyofauna is represented by 66 species of teleost fishes including 24 families. The family Sciaenidae has greatest number of species (13), and is the most important in the fisheries.

There are 50 species of marine fishes, 7 species typically euryaline and 9 fresh water species.

The ichthyofauna has distinctive characteristics in relation to that of the estuaries in the eastern part of northeast Brazil. (Auth. summ.)

75-000526 Gold, J. R.; Gall, G. A. E. (Dep. Anim. Sci., Univ. Calif., Davis 95616) FURTHER RECORD OF LITTLE KERN GOLDEN TROUT, /*SALMO AGUABONITA WHITEI*/, IN THE LITTLE KERN RIVER, BASIN, CALIFORNIA. Calif. Fish Game 61 (4): 248-250. Oct. 1975. SFA 20(4).

75-000527 Grant, E. M. (Queensl. Fish. Serv., 76-86 George St., Brisbane, 4000, Australia) GUIDE TO FISHES. The Co-ordinator-General's Dep., Brisbane, Australia f1975. Available from the Co-ordinator-General's Dep., Brisbane, Australia, at (A).50 plus postage. SFA 20(4).

The purposes of this book are to provide an aid to commercial fishermen and anglers in the visual identification of the principal fish species of Queensland, to assist the amateur naturalist in distinguishing between related species, and to give a taxonomic description or diagnosis for the scientific worker. Over 700 fish are dealt with, and 307 colour-plates and 257 in black-and-white are included.

75-000528 Mearns, A. J. (1500 E. Imperial Highway, El Segundo, CA 90245) /*POECILIOPSIS GRACILIS*/ (HECKEL), A NEWLY INTRODUCED POECILID FISH IN CALIFORNIA. Calif. Fish Game 61 (4): 251-253. Oct. 1975. SFA 20(4).

75-000529 Netsch, N. F. (U.S. FWS, 813 D Street, Anchorage, AK 99501) FISHERY RESOURCES OF WATERS ALONG THE ROUTE OF THE TRANS-ALASKA PIPELINE BETWEEN YUKON RIVER AND ATIGUN PASS IN NORTH CENTRAL ALASKA. U.S. Fish Wildl. Serv. Resour. Publ. 124. v + 45p. 1975. SFA 20(4).

Fishery resources along a 185-mile segment of the trans-Alaska pipeline route between the Yukon River and Atigun Pass are described. Of 209 waters surveyed in 1971, 110 supported fish. In general, all streams that had a permanent flow of water in a defined channel and no barriers supported fish. Of 19 species present in the study area, Arctic grayling (/Thymallus arcticus/), slimy sculpin (/Cottus cognatus/), and round whitefish (/Prosopium cylindraceum/) were most common.

Intensive studies were conducted on Jim River, Prospect Creek, and stream HR2-1405+92 in 1972. During the summer 2,226 grayling were tagged of which 387 (17 percent) were recaptured one or more times. Although movements differed with size of fish and with size of streams, the present study and others have suggested the following seasonal sequence: Adult grayling may begin upstream movements under the ice in the spring; part of the population then moves on into smaller streams as soon as the ice is out and water temperatures rise; immature fish generally follow closely behind the adults. Adults move out of many small streams immediately after spawning, but most immatures do not leave until late August or September. There is a general downstream movement of all sizes of grayling in the fall, presumably to overwintering areas.

The estimated number of grayling 200 mm long (fork length) or longer in a 2-mile section of Jim River was 3,496 in June and increased each month to a high of 15,043 in October. Estimated numbers were 1,572 in July and 1,210 in August in the lower mile of Prospect Creek and 454 in stream HR2-1405+92 during June. Grayling spawned in the Jim River area from 28 May to 11 June 1972. Grayling averaged 70 mm at the end of their first summer and required four growing seasons before the fastest growing individuals reached 200 mm. Small numbers of chinook and chum salmon spawned in Jim River between Prospekt Camp and the pipeline crossing and young Chinook salmon were common in the Jim River and Prospect Creek.

75-000529 CONTINUED

Variation was considerable among sampling methods used to estimate catch rates, species caught, length-frequencies of the catch, and mortality of fish caught. Suitability for use of the methods under different conditions also varied and no single method was best for all purposes.

To minimize potential adverse impacts upon aquatic resources, the government must impose restrictions on construction activities. The type of restriction will vary from stream to stream.

75-000530 Oppi, E. (Museo Civico di Storia Naturale, Verona, Italy) PRESENZA DEL GENERE /CHONDROSTOMA/ (L. AGASSIZ, 1835) NEL LAGO DI GARDA. [OCCURENCE OF GENUS /CHONDROSTOMA/ (L. AGASSIZ, 1835) IN LAKE GARDA.] Riv. It. Piscic. Ittiop. 10 (2): 43-44. Apr.-May/June 1975. In Italian with English summ. SFA 20(4).

The author reported the occurrence of /Chondrostoma soetta/ and /C. toxostoma/ in Lake Garda, two cyprinids that are considered very unusual in that lake, and likely entered through the emissary Mincio River. (Auth. Summ.)

ABUNDANCE, FACTORS OF; SURVIVAL AND MORTALITY

75-000531 Adams, B. L.; Zaugg, W. S.; McLain, L. R. (Western Fish Dis. Lab., Cook, WA 98605) INHIBITION OF SALT WATER SURVIVAL AND NA-K-ATPASE ELEVATION IN STEELHEAD TROUT (/SALMO GAIRDNERI/) BY MODERATE WATER TEMPERATURES. Trans. Am. Fish. Soc. 104 (4): 766-769. Oct. 1975. SFA 20(4).

The steelhead trout metamorphosis from a freshwater parr to a sea water-tolerant smolt possessing the migration tendency was evaluated at six different growth temperatures ranging from 6 to 15 C during January through July. The highest temperature where a transformation was indicated was 11.3 C. By April fish reared at 6 C had elevated ATPase levels typical of smolts or migratory animals and showed 92 percent survival in sea water. Ten and 11.3 C-reared fish showed a short-lived elevation in ATPase in mid-April alone concurrently with 100 percent sea water survival at that time. Only in 6 C-reared animals did the salt water survival ability continue into May. High ATPase levels likewise were prolonged into May and June only in the 6 C-reared group. The data indicate that metamorphosis (and therefore successful migration) of juvenile steelhead trout is directly controlled by water temperatures.

75-000532 Austin, H. M.; Sosnow, A. D.; Hickey, C. R., Jr. (Dep. Fish. Oceanogr., N.Y. Ocean Sci. Lab., Montauk 11954) THE EFFECTS OF TEMPERATURE ON THE DEVELOPMENT AND SURVIVAL OF THE EGGS AND LARVAE OF THE ATLANTIC SILVERSIDE, /MENIDIA MENIDIA/. Trans. Am. Fish. Soc. 104 (4): 762-765. Oct. 1975. SFA 20(4).

Eggs of Atlantic silverside, /Menidia menidia/, were fertilized and incubated at 15, 17, 20, 25 and 30 C. The times to hatching at each temperature were 27.0, 12.4, 9.8, 4.8 and 3.0 days respectively. Thermal shocks of +8 C produced 0 percent mortality for larvae reared at 17 and 20 C, 19 percent for larvae reared at 25 C, and 11 percent for larvae reared at 30 C. Thermal shocks of +14 C produced 3 percent mortality for larvae reared at 17 C, 0 percent for larvae reared at 20 C, and 100 percent for larvae reared at 25 and 30 C. Since the larvae of /Menidia menidia/ are present in Long Island Sound when temperatures are in the 15-20 C range, it appears that the population will undergo a minimum of stress due to thermal shock as a result of nuclear power plant development on Long Island.

75-000533 Ayles, G. B.; Lark, J. G. I. (Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB R3T 2N6, Canada) SUMMER MORTALITY OF RAINBOW TROUT (*/SALMO GAIARDNERI/*) IN CANADIAN POTHOLE LAKES. Presented at the Canadian Conference for Freshwater Fisheries Research, Jan. 6-7, 1975. 17p. Jan. 1975. SFA 20(4).

Unexplained mortality is the major biological factor impeding development of extensive culture of rainbow trout in prairie pothole lakes. In the summer of 1974, an experiment was set up in the area around Erickson, Manitoba, to examine this problem. Relative population size was monitored by means of 'survey' gill nets, and small holding cages, in 4 high summerkill risk lakes, and 4 control lakes. Mark-recapture techniques were used to obtain monthly population estimates in 5 of the 8 lakes. The mortality patterns are presented, and known and possible causes of mortality are discussed. These patterns are presented in conjunction with data on seasonal variation in some chemical parameters.

75-000534 Clady, M.; Hutchinson, B. (Dep. Nat. Resour., Cornell Univ., Ithaca, NY 14853) EFFECT OF HIGH WINDS ON EGGS OF YELLOW PERCH, */PERCA FLAVESCENS/*, IN ONEIDA LAKE, NEW YORK. Trans. Am. Fish. Soc. 104 (3): 524-525. July 1975. SFA 20(4).

As a result of one day of high winds, large quantities of eggs of yellow perch, */Perca flavescens/*, were washed ashore at a number of locations in the windward shoreline, of Oneida Lake. A single large windrow, just downwind from a major spawning area, contained almost one percent of the estimated egg potential of the Lake's perch population. Damage to the dislodged egg masses appeared most severe in areas with rubble bottoms.

75-000535 Gibson, R. J.; Galbraith, D. (Woods Hole Oceanogr. Inst., Woods Hole, MA 02543) THE RELATIONSHIPS BETWEEN INVERTEBRATE DRIFT AND SALMONID POPULATIONS IN THE MATAMEK RIVER, QUEBEC, BELOW A LAKE. Trans. Am. Fish. Soc. 104 (3): 529-535. July 1975. SFA 20(4).

The amount of daily invertebrate drift in the Matamek River varied both seasonally and down the length of the river. From June to September 1973, the volume of drift was about eight times greater in June than in August. Filter feeding insects and planktonic crustacea were more numerous at the upstream station near a lake, than at a station 4 km downstream. Larvae of net-spinning Trichoptera were twice as abundant at the upstream station, and simuliid larvae four times as abundant. Numbers of zooplankton closely followed changes in water level, and were highest in early summer and the fall, and were lowest in August. The salmonid biomass was at least four times greater at the upstream station than the lower one, most likely the result of a greater abundance of insect larvae suitable as food nearer the lake.

75-000536 Ware, D. M. (Fish. Mar. Serv., Bedford Inst. Oceanogr., Dartmouth, NS B2Y 4A2, Canada) RELATION BETWEEN EGG SIZE, GROWTH, AND NATURAL MORTALITY OF LARVAL FISH. J. Fish Res. Board Can. 32 (12): 2503-2512. Dec. 1975. In English with French summ. SFA 20(4).

A set of density-dependent growth and survivorship equations is derived from evidence that the instantaneous death rate in the sea is inversely proportional to particle size. The survivorship equation reproduces several well-known phenomena observed in fish populations. It predicts: 1) that winter and spring spawning species ought to produce larger eggs than summer spawners, 2) that it is advantageous for species that spawn in batches to produce progressively smaller eggs in spring and summer, and 3) that the death rate of a cohort of

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fish should decrease continuously as the survivors grow and approach the critical size.

The biological basis for the observed variation in the size of pelagic fish eggs and larvae is thought to be due primarily to trophic relations within the pelagic community. It is suggested from what is known of the relative abundance and foraging capabilities of different sized particles, that the survival rates of larval and juvenile fish should increase as they grow and occupy a progressively higher position in the food chain.

IDENTIFICATION, KEYS, CLASSIFICATION

75-000537 Colman, J. A. (Fish. Res. Div., Minist. Agric. Fish., Wellington, New Zealand) JUVENILE FORM OF THE NEW ZEALAND TURBOT /COLISTIUM NUDIPINNIS/ (WAITE) (PISCES: HETEROSOMATA: RHOMBOSOLEINAE). N. Z. J. Mar. Freshwater Res. 9 (4): 575-579. Dec. 1975. SFA 20(4).

A juvenile (26 mm) specimen of the New Zealand turbot /Colistium nudipinnis/ (Waite) is figured and described. Differences between the juvenile and adult forms, and characters distinguishing juvenile /C. nudipinnis/ from the young of other New Zealand species of flatfish, are noted.

75-000538 Knight, A. E.; Hughes, W. A. (U.S. FWS, Laconia, NH 03246) SEPARATION OF PRE-SMOLT ATLANTIC SALMON AND JUVENILE BROWN TROUT WITH PENDUNCLE DEPTH TO TOTAL LENGTH RATIOS. Prog. Fish-Cult. 37 (4): 194-196. Oct. 1975. SFA 20(4).

The mean ratio of penduncle depth to total length for 100 juvenile brown trout (/Salmo trutta/ Linnaeus) was found to be 0.090, while the mean ratio of penduncle depth to total length for 103 Atlantic salmon (/Salmo salar/ Linnaeus) was found to be 0.070. This character is useful for field identification, since the range of these ratios does not overlap between species.

PARASITES AND DISEASES-GENERAL

75-000539 Conrad, J. F.; Holt, R. A.; Kreps, T. D. (Oreg. Dep. Fish Wildl., 17330 S.E. Evelyn St., Clackamas 97045) OZONE DISINFECTION OF FLOWING WATER. Prog. Fish-Cult. 37 (3): 134-136. July 1975. SFA 20(4).

The bactericidal efficacy of ozone in flowing water was evaluated by bacterial plate count and bioassay. Exposure at 13 degrees and 21 degrees C of 2.8 liters/min-flow spring water that contained known numbers of viable /Flexibacter columnaris/ cells resulted in more than 99 percent kill. Innovation in fish husbandry techniques (water reuse, semi-closed systems, etc.) coupled with more stringent requirements for fish hatchery effluent "clean-up" present an ever-growing need for safe, effective, and economical disinfection of fish hatchery influent and effluent. In response to this need we investigated ozone, a potent germicide that is extensively used in Europe and Japan to disinfect waste water.

75-000540 Hare, G. M.; Burt, M. D. B. (Fish. Mar. Serv., Biol. Stn., St. Andrews, NB E0G 2X0, Canada) ABUNDANCE AND POPULATION DYNAMICS OF PARASITES INFECTING ATLANTIC SALMON (*SALMO SALAR*) IN TROUT BROOK, NEW BRUNSWICK, CANADA. J. Fish. Res. Board Can. 32 (11): 2069-2074. Nov. 1975. In English with French summ. SFA 20 (4).

Ten species of parasites (8 helminth, 1 annelid, 1 mollusc) were collected from 375 juvenile Atlantic salmon (*Salmo salar*) in Trout Brook, N.B., during May-November 1970 and 1971. The most commonly occurring parasites were the monogenean *Discocotyle sagittata* (infecting 37.7 percent of the fish examined), the digenean *Crepidostomum farionis* (40.5 percent), the nematode *Sterliadochona tenuissima* (97.9 percent), and a glochidium (32.0 percent). Intensity of infection (mean number of parasites for all fish examined) of *C. farionis* and *S. tenuissima* was independent of host age and sex, and of *D. sagittata* was independent of age, but male salmon were more heavily infected than females. The intensity of infection of these parasites showed no interactions between host age and season nor between host sex and season. The abundance of the parasites showed marked seasonal changes: *D. sagittata* was most abundant in summer and autumn, *C. farionis* and *S. tenuissima* were most abundant in spring, and the glochidium was most abundant in autumn. Relationships between changes in parasite maturation and in seasonal abundance indicated annual cycles of infection.

75-000541 Hensley, G. H.; Nahhas, F. M. (Biol. Sci., Los Medanos Coll., 2700 E. Leland Rd., Pittsburg, CA 94565) PARASITES OF FISHES FROM THE SACRAMENTO-SAN JOAQUIN DELTA, CALIFORNIA. Calif. Fish Game 61 (4): 201-205. Oct. 1975. SFA 20 (4).

Between June of 1972 and June of 1973, 545 fishes representing 28 species were examined, revealing the presence of the following parasites:

Protozoa: *Myxobolus koi*/ Kudo, 1920 from *Cyprinus carpio*/.
Trematoda: *Dactylogyrus extensus*/ Mueller and Van Cleave, 1932 from *Cyprinus carpio*/. *Cleidodiscus pricei*/ Mueller, 1936 from *Ictalurus catus*/. *I. melas*/. *Morone saxatilis*/. and *Chaenobryttus gulosus*/. *Posthodiplostomum minimum centrarchi*/ (MacCallum, 1921; Dubois, 1936) Hoffman, 1958 from *Chaenobryttus gulosus*/ and *Lepomis macrochirus*/. *Clinostomum marginatum*/ (Rudolphi, 1819) from *Chaenobryttus gulosus*; and *Alloglossidium corti*/ (Lamont, 1921) Mueller, 1930 from *Ictalurus catus*/. *I. nebulosus*/. and *I. punctatus*/.
Cestoda: *Artactolytocestus huronensis*/ Anthony, 1958 from *Cyprinus carpio*/. *Khawia iowensis*/ Calentine and Ulmer, 1961 from *Cyprinus carpio*/. *Corallobothrium giganteum*/ Essex, 1927 from *Ictalurus catus*/. *I. punctatus*/. and *I. melas*/. *Corallobothrium fimbriatum*/ Essex, 1927 from *Ictalurus catus*/. *I. punctatus*/. and *I. melas*/. *Bothriocephalus claviceps*/ (Goeze, 1782) Rudolphi, 1810 from *Lepomis macrochirus*/. *Pelichnibothrium speciosum*/ Monticelli, 1889 from *Alosa sapidissima*/. and *Lacistorhynchus*/ sp. from *Morone saxatilis*/.
Nematoda: *Philometra carassii* (Ishii, 1934) from *Carrassius auratus*/. *Capillaria catenata*/ Mueller and Van Cleave, 1932 from *Cyprinus carpio*/. *Contracaecum brachyurum*/ (Ward and Magath, 1917) from *Ictalurus catus*/. *Morone saxatilis*/. *Pomoxis nigromaculatus*/. and *Alosa sapidissima*/. *Contracaecum spiculigerum*/ (Rudolphi, 1809) from *Ictalurus nebulosus*/. *Raphidascaris*/ sp. from *Alosa sapidissima*/. *Metabronema salvelini*/ (Fujita, 1922) from *Pogonichthys macrolepidotus*/. and *Spiroxya*/ sp. from *Morone saxatilis*/.
Hirudinea: *Illinobdella moorei* (Meyer, 1940) Meyer, 1946 from *Ictalurus catus*/.
Crustacea: *Lernaea cyprinacea*/ Linnaeus, 1761 from *Ictalurus catus*/. *Mylopharodon conocephalus*/. *Orthodon microlepidotus*/.
1975

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/Pogonichthys macrolepidotus/, and /Ptychocheilus grandis/.

New Geographic distributions include: /Myxobolus koi/ Kudo, 1920 (Protozoa); /Atractolytocestus huronensis/ Anthony, 1958; /Khawia iowensis/ Calentine and Ulmer, 1961; and /Bothriocephalus claviceps/ (Goeze, 1782) Rudolphi, 1810, (Cestoda); /Philometra carassii/ (ishii, 1934); /Capillaria catenata/ Mueller and Van Cleave, 1932; and /Contracaecum brachyurum/ (Ward and Magath, 1917), (Nematoda); /Illinobdella moorei/ (Meyer, 1940) Meyer, 1946 (Hirudinea).

A list of fishes negative for parasites is included.

75-000542 Wright, F. T. (Rt. 1, Box 17A, Kearneysville, WV 25430) ATLANTIC SALMON (/SALMO SALAR/): AN ANNOTATED BIBLIOGRAPHY. U.S. Fish Wildl. Serv. Tech. Pap. 83. 22p. 1975. SFA 20(4).

BACTERIAL DISEASES

75-000543 Bullock, G. L.; Stuckey, H. M. (U.S. FWS, Eastern Fish Dis. Lab., Kearneysville, WV 25430) /AEROMONAS SALMONICIDA/: DETECTION OF ASYMPTOMATICALLY INFECTED TROUT. Prog. Fish-Cult. 37 (4): 237-239. Oct. 1975. SFA 20(4).

The combination of Kenalog injection and heat stress proved effective in causing overt furunculosis among carrier trout; however the system requires that injected trout be held as long as 2 wk in heated water. This procedure is recommended where furunculosis is suspected but where other methods of detection (such as monitoring hatchery mortality) have failed, or where the level of /A. salmonicida/ agglutinins indicated the possible presence of the causal bacterium. (From Auth. Discuss.)

75-000544 Bullock, G. L.; Stuckey, H. M.; Wolf, K. (East. Fish Dis. Lab., Rt. 1, Box 17A, Kearneysville, WV 25430) BACTERIAL KIDNEY DISEASE OF SALMONID FISHES. U.S. Fish Wildl. Serv. Fish Dis. Leaflet. FDL-41. 7p. 1975. SFA 20(4).

75-000545 Bullock, G. L.; Stuckey, H. M. (U.S. FWS, East. Fish. Dis. Lab., Kearneysville, WV 25430) FLUORESCENT ANTIBODY IDENTIFICATION AND DETECTION OF THE /CORYNEBACTERIUM/ CAUSING KIDNEY DISEASE OF SALMONIDS. J. Fish. Res. Board Can. 32 (11): 2224-2227. Nov. 1975. In English with French summ. SFA 20(4).

An indirect fluorescent antibody technique (FAT) has been developed for serological identification, diagnosis of kidney disease (KD), and detection of subclinical infections of KD. Rabbit or goat antikidney disease serum and appropriately labeled immunoglobulin was found to be specific for the KD bacterium. The technique was superior to examination of gram-stained smears for detection of small numbers of KD bacteria. The test requires approximately 2 h.

75-000546 Bullock, G. L.; Snieszko, S. P. (East. Fish Dis. Lab., Rt. 1, Box 17A, Kearneysville, WV 25430) HAGERMAN REDMOUTH, A DISEASE OF SALMONIDS CAUSED BY A MEMBER OF THE ENTEROBACTERIACEAE. U.S. Fish Wildl. Serv. Fish. Dis. Leaflet. FDL-42. 5p. 1975. SFA 20(4).

75-000547 Busch, R. A.; Lingg, A. J. (Sch. Nat. Resour., Humboldt Univ., Arcata, CA 95521) ESTABLISHMENT OF AN ASYMPTOMATIC CARRIER STATE INFECTION OF ENTERIC REDMOUTH DISEASE IN RAINBOW TROUT (*SALMO GAIIRDNERI*). J. Fish. Res. Board Can. 32 (12): 2429-2432. Dec. 1975. In English with French summ. SFA 20(4).

The dynamics of establishment, pathogenesis, and continued maintenance of Enteric Redmouth (ERM) disease in rainbow trout (*Salmo gairdneri*) were examined. Groups were infected by parenteral and oral routes and subsampled at weekly intervals. Both modes of infection were standardized to obtain ID(100) levels of infection with an average of 30 bacteria constituting an LD(50) dosage when administered parenterally. The clinical course of the disease was monitored up to 102 days postinfection. A clinically asymptomatic carrier state infection was established in the lower intestine of 25 percent of survivors 45 days postinfection at 14.5 C. Thereafter, regular intestinal shedding of the pathogen, causing recurrent infection and mortality within the population, occurred on a cyclic basis of 30-40 day intervals. Clinical recovery, establishment of the asymptomatic condition, and periodicity of intestinal shedding and the clinical course of the disease to convalescence were described.

75-000548 Ghittino, P.; Andruetto, S.; Vigliani, E. (Ist. Zooprof. Sperim. Via Bologna, 148-10154 Torino, Italy) GRAVE VIBRIOSI IN TROTE IRIDEE ALLEVATE IN ACQUA SALSA. [A SERIOUS VIBRIOSIS IN RAINBOW TROUT GROWN IN SALT WATER.] Riv. It. Piscic. Ittiop. 10 (4): 113-115. Oct.-Nov.-Dec. 1975. In Italian with English summ. SFA 20(4).

The authors reported a serious Vibriosis in rainbow trout experimentally cultivated in a cage floating in a sea-water Italian lagoon. All the lesions found in trout were in accordance with the literature, especially the formation of "furuncles". The disease was recognized as caused by *Vibrio anguillarum*. An interaction of three sets (fish-host, pathogen, environment) may be speculated in this disease onset.

Authors suggested a control programme by means of medicated foods (chemio-prophylaxis) or by immunization with specific vaccine. A MD (Minimum Disease) programme could be suggested as the only possible in such intensive sea-water fish farmings.

75-000549 Hendricks, J. D.; Leek, S. L. (Dep. Food Sci. Tech., Oreg. State Univ., Corvallis 97331) KIDNEY DISEASE POSTORBITAL LESIONS IN SPRING CHINOOK SALMON (*ONCORHYNCHUS TSHAWYTSCHA*). Trans. Am. Fish. Soc. 104 (4): 805-807. Oct. 1975. SFA 20(4).

Gross exophthalmos in one or both eyes of yearling spring chinook salmon (*Oncorhynchus tshawytscha*) was caused by postorbital, granulomatous inflammatory tissue that developed in response to invasion of the site by *Corynebacterium* sp., the causative agent of bacterial kidney disease.

75-000550 Holt, B. A.; Conrad, J. F.; Fryer, J. L. (Oreg. Dep. Fish Wildl., 17330 S.E. Evelyn St., Clackamas 97045) FURANACE FOR CONTROL OF *CYTOPHAGA PSYCHROPHILA*/ THE CAUSATIVE AGENT OF COLD-WATER DISEASE IN COHO SALMON. Prog. Fish-Cult. 37 (3): 137-139. July 1975. SFA 20(4).

Furanace, a nirtofuran chemotherapeutic agent, had a minimal inhibitory concentration of 0.008 ug/ml of broth for *Cytophaga psychrophila*; but concentrations of 4.0 to 8.0 ug/ml Furanace were needed to produce a bactericidal effect. In *in vivo* studies, 0.5 ug/ml Furanace added to the water containing young coho salmon apparently provided effective protection against a natural outbreak of cold-water disease.

75-000551 Holt, R. A.; Sanders, J. E.; Zinn, J. L.; Fryer, J. L.; Pilcher, K. S (Dep. Microbiol., Oreg. State Univ., Corvallis 97331) RELATION OF WATER TEMPERATURE TO /FLEXIBACTER COLUMNARIS/ INFECTION IN STEELHEAD TROUT (/SALMO GAIRDNERI/), COHO (/ONCORHYNCHUS KISUTCH/) AND CHINOOK (/O. TSHAWYTSCHA/) SALMON. J. Res. Fish. Board Can. 32 (9): 1553-1559. Sept. 1975. In English with French summ. SFA 20(4).

The effect of water temperature upon mortality from experimental infection by /Flexibacter columnaris/ and on mean time to death was investigated in juvenile steelhead trout (/Salmo gairdneri/), coho salmon (/Oncorhynchus kisutch/), and spring chinook salmon (/Oncorhynchus tshawytscha/). Eight temperatures increasing from 3.9 to 23.3 C (39 to 74 F) by increments of 2.8 C (5 F) were studied. Fish were infected by the direct contact method whereby a suspension of the pathogen was added to the water. It was found that at temperatures of 9.4 C (49 F) and below, no deaths due to the experimental infection with /F. columnaris/ occurred. At 12.2 C (54 F) mortality varied from 4 to 20 percent among the three species, and increased progressively with increasing temperature to 100 percent in steelhead trout and coho salmon at 20.5 C (69 F), and 70 percent in chinook salmon at temperature. With all three salmonid species, and inverse linear relationship was found between water temperature and the log(10) of the mean number of days from exposure to death. This means that as the temperature increases above 12.2 C (54 F), and disease process was progressively accelerated, resulting in a minimum time to death at 20.5 or 23.3 C (69 or 74 F) and a maximum at 12.2 C (54 F). The results indicate that under the conditions of these experiments, columnaris disease in salmonids was completely suppressed by water temperatures of 9.4 C (49 F) or below.

75-000552 Wright, L. D.; Snow, J. R. (U.S. FWS, Marion Natl. Fish Hatchery, Marion, AL 36756) THE EFFECT OF SIX CHEMICALS FOR DISINFECTION OF LARGEMOUTH BASS EGGS. Prog. Fish-Cult. 37 (4): 213-217. Oct. 1975. SFA 20(4).

Six chemicals (formalin, acriflavine, Roccal, Merthiolate, Betadine, and Wescodyne) were compared in their effectiveness as disinfectants to be used in the incubation of largemouth bass, /Micropterus salmoides/, eggs. Eggs infected with /Aeromonas liquefaciens/ were subjected to 15-minute treatments of varying concentrations of the test chemicals. Merthiolate, acriflavine, Betadine, and Wescodyne proved to be bactericidal at concentrations tolerated by bass eggs. The treatments of choice are acriflavine at 500-700 ppm and Betadine at 100-150 ppm active I(2). Roccal at effective concentrations was detrimental to the eggs. Formalin up to 2,000 ppm was not an effective bactericide.

FUNGAL DISEASES

75-000553 Ross, A. J.; Yasutake, W. T.; Leek, S. (West. Fish. Dis. Lab., Bldg. 204, Naval Support Act., Seattle, WA 98115) /PHOMA HERBARUM/, A FUNGAL PLANT SAPROPHYTE, AS A FISH PATHOGEN. J. Fish. Res. Board Can. 32 (9): 1648-1652. Sept. 1975. In English with French summ. SFA 20(4).

/Phoma herbarum/, a fungal plant saprophyte, was isolated from diseased hatchery-reared coho salmon (/Oncorhynchus kisutch/), chinook salmon (/O. tshawytscha/), and rainbow trout (/Salmo gairdneri/). The disease was observed at 10 national fish hatcheries in Washington and Oregon, but the low incidence of experimental infections indicate that

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it is only weakly contagious. Histopathological examination suggests that air bladder is one of the primary organs infected. The visceral organs are also affected in both natural and experimental infections.

PROTOZOAN DISEASES

75-000554 Margolis, L.; Evelyn, T. P. T. (Fish. Mar. Serv., Pacific Biol. Stn., Nanaimo, BC V9R 5K6, Canada) /CERATOMYXA SHASTA/ (MYXOSPORIDA) DISEASE IN CHUM SALMON (/ONCORHYNCHUS KETA/) IN BRITISH COLUMBIA. J. Fish. Res. Board Can. 32 (9): 1640-1643. Sept. 1975. In English with French summ. SFA 20(4).

Infections with the myxosporidan /Ceratomyxa shasta/ Noble, 1950 were confirmed in four juvenile chum salmon (/Oncorhynchus keta/) caught at sea near Nanaimo in 1965 and 1968. These cases represent a new host record for /C. shasta/ and a northward extension of the parasite's known natural range. Ceratomyxosis was also presumptively diagnosed in a coho salmon (/Oncorhynchus kisutch/) in British Columbia.

75-000555 O'Grodnick, J. (Benner Spring Fish Res. Stn., Bellefonte, PA 16823) EGG TRANSMISSION OF WHIRLING DISEASE. Prog. Fish-Cult. 37 (3): 153-154. July 1975. SFA 20(4).

A 3-yr study to determine whether whirling disease-free rainbow trout (/Salmo gairdneri/) could be raised from the eggs of infected breed stock was initiated in 1971 at the Benner Spring Fish Research Station, Bellefonte, by the Pennsylvania Fish Commission. Infected rainbow trout were spawned during the fall of 1971, 1972, and 1973, and the fingerlings were raised in whirling disease-free spring water. At the end of the 5-mo. test period, 60 fish were sacrificed and examined for whirling disease spores. No spores were found in any sample during this period.

75-000556 Udey, L. R.; Fryer, J. L.; Pilcher, K. S. (Dep. Microbiol., Oreg. State Univ., Corvallis 97331) RELATION OF WATER TEMPERATURE TO CERATOMYXOSIS IN RAINBOW TROUT (/SALMO GAIRDNERI/) AND COHO SALMON (/ONCORHYNCHUS KISUTCH/). J. Fish. Res. Board Can. 32 (9): 1545-1551. Sept. 1975. In English with French summ. SFA 20(4).

Juvenile rainbow trout (/Salmo gairdneri/) were exposed to infection with /Ceratomyxa shasta/, transferred in groups of 25 to aquaria, and tempered to various temperature levels increasing from 3.9 to 23.3 C (39 to 74 F) by 2.8 degree C (5 degree F) increments. During a 237-day observation period mortality in the experimental groups averaged about 80 percent, and was independent of water temperature between 6.3 and 23.3 C (44 and 74 F). No deaths occurred at 3.9 C (39 F). The geometric-mean time from exposure to death, however, was definitely a function of temperature, increasing from 14 days at 23.3 C (74 F) to 155 days at 6.7 C (44 F).

A similar experiment with juvenile coho salmon (/Oncorhynchus kisutch/) have quite different results. In this species, percent mortality due to /C. shasta/ increased progressively from 2 percent at 9.4 C (49 F) to 22 percent at 15.0 C (59 F) and 84 percent at 20.5 C (69 F). No deaths occurred at 3.9 or 6.7 C (39 or 44 F) during the 201-day experimental period. As with the rainbow trout, the geometric-mean time from exposure to death was temperature dependent, increasing from 12.5 days at 23.3 C (74 F) to 146 days at 9.4 C (49 F). The data indicate that ceratomyxosis in coho can be suppressed by water temperatures of 6.7 C (44 F) or below.

VIRAL DISEASES

75-000557 Meier, W.; Jorgensen, P. E. V. (Vet.-Bacteriol. Inst., Univ. Bern, Langgass Strasse 122, 3001 Bern, Switzerland) A RAPID AND SPECIFIC METHOD FOR THE DIAGNOSIS OF VIRAL HAEMORRHAGIC SEPTICAEMIA (VHS) OF RAINBOW TROUT. Riv. It. Piscic. Ittiop. 10 (1): 11-18. Jan.-Feb.-Mar. 1975. In English and Italian. SFA 20(4).

The present report describes the application of the indirect fluorescent antibody technique (IFAT) as a rapid method for the diagnosis of viral haemorrhagic septicaemia (VHS) of rainbow trout. The method has been compared to the virus isolation method with regard to rapidity and sensitivity.

By means of the IFAT a highly specific positive diagnosis can be obtained after 24 hours. Maximum sensitivity is reached after 48 hours, when the test will allow demonstration of low virus titres.

The conventional virus isolation and identification test in cell cultures requires between one and two weeks. (Auth. Summ.)

OTHER DISEASES AND PARASITES

75-000558 Angell, C. L.; Miller, B. S.; Wellings, S. R. (Univ. Wash., Coll. Fish., Fish. Res. Inst., Seattle 98195) EPIZOOTIOLOGY OF TUMORS IN A POPULATION OF JUVENILE ENGLISH SOLE (/PAROPHRYS VETULUS/) FROM PUGET SOUND, WASHINGTON. J. Fish. Res. Board Can. 32 (10): 1723-1732. Oct. 1975. In English with French summ. SFA 20(4).

An epizootic skin tumor disease affected young-of-the-year English sole (/Parophrys vetulus/) near Seattle, Wash. The 1969 year-class had an incidence of 18.7 percent. The epizootic wave began in August and peaked in October. Incidence rapidly declined thereafter. The disease coincidentally attacked winter and summer influxes. There was no difference in growth between age-group 0 normal and tumorous fish, but age distribution of tumorous fish indicated longevity differed. Tumors were more numerous on younger fish. Angioepithelial nodules grew until transforming into epidermal papillomas, which reached maximum weight in age-group II. There were no differences in sex ratios between normal and tumorous fish.

75-000559 Cramer, S. P.; McIntyre, J. D. (Oreg. Wildl. Comm., Gold Beach 97444) HERITABLE RESISTANCE TO GAS BUBBLE DISEASE IN FALL CHINOOK SALMON, /ONCORHYNCHUS Tshawytscha/. NOAA Fish. Bull. 73 (4): 934-938. Oct. 1975. SFA 20(4).

Differences between stocks indicated that selection for phenotypes with greatest resistances to gas bubble disease has occurred in the Columbia River. This conclusion was supported by the observation that stocks with the longest histories of exposure to air-supersaturated water were most resistant to gas bubble disease.

Because additive genetic variance contributing to the observed differences probably has been reduced, and reduced at an unknown rate, it is impossible to estimate accurately the selection intensities that must have occurred in the past to produce the differences in resistance observed between Trask and Columbia River stocks. The low heritability for resistance to gas bubble disease in fall chinook salmon indicates that no great increases in resistance can be expected even at relatively high selection intensities.

The results further indicate that stocks transferred from coastal streams to hatcheries within the Columbia River drainage may

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experience high levels of mortality from gas bubble disease. On the other hand, Columbia River stocks may provide a source of brook fish that are resistant to gas bubble disease for stocking in other waterways. (Auth. Discussion)

75-000560 Dawley, E. M.; Ebel, W. J. (NMFS, 2725 Montlake Blvd. East, Seattle, WA 98112) EFFECTS OF VARIOUS CONCENTRATIONS OF DISSOLVED ATMOSPHERIC GAS ON JUVENILE CHINOOK SALMON AND STEELHEAD TROUT. NOAA Fish. Bull. 37 (4): 787-796. Oct. 1975. SFA 20(4).

Bioassays in shallow tanks (25 cm deep) with dissolved nitrogen and argon gas concentrations ranging from 100 to 125 percent of saturation in water at 15°C were conducted to determine lethal and sublethal effects on juvenile chinook salmon, *Oncorhynchus tshawytscha*, and steelhead trout, *Salmo gairdneri*. Significant mortality of both species commenced at 115 percent saturation of nitrogen and argon (111 percent saturation of total dissolved atmospheric gas pressure). Over 50 percent mortality of both steelhead and chinook occurred in less than 1.5 days in water at 120 and 125 percent of saturation. Significant differences in swimming performance, growth, and blood chemistry were measured in groups of fish tested at sublethal exposures in various concentrations of dissolved gases. Sublethal stress for 35 days at 110 percent dissolved nitrogen (106 percent total atmospheric gas) decreased normal swimming ability of chinook. Growth of both steelhead and chinook was affected by sublethal exposures in water saturated with atmospheric nitrogen and argon at 105, 110, and 115 percent. Blood chemistry was affected at sublethal exposures in water at 115 percent saturation.

75-000561 Ghittino, P. (Ist. Zooprofil. Sperim., Via Bologna, 148-10154 Torino, Italy) THE RAINBOW TROUT AND ITS NEOPLASMS: A FERAL FISH CONVERTED TO A CANCER RESEARCH ANIMAL. Riv. It. Piscic. Ittiop. 10 (1): 21-29. Jan.-Feb.-March 1975. In English and Italian. SFA 20(4).

Tumors, widely occurring also in fish, are interesting from several viewpoints. Their study may enable workers to understand problems of tumorigenesis related to cancer-phylogeny, -evolutionary origin, -comparative pathology, -environmental, -geographical, nutritional -epidemiology, and to contribute to solve tumor etiology and control. Fish can be good indicators of carcinogens, of viral or chemical nature, in the habitat or food cycle. Chronic water pollution is suspected as an important factor favouring the onset of epidemic fish tumors in nature. Other fish tumors have been demonstrated to be linked to nutritional factors. For example, viral etiology has been indicated in eel papilloma, probably enhanced by water pollution. The frontal attack to the trout hepatoma problem, mostly undertaken in the USA through coordinate studies, showed that this tumor was linked to the extensive use in trout feeding of dry pellets which contained ingredients (peanut-, cottonseed-meals) contaminated by aflatoxins. Trout appeared, more than any other animal, tremendously susceptible to aflatoxin-cancerogenesis.

Fish tumors previously known in sporadic cases, appeared epizootic after studies on fishpathology increased, and fish were grown in fish farms. With more knowledge on fish tumors, fish could be adapted for some experimental carcinogenesis studies (hepatomagenesis in trout and zebrafish, trout nephroblastoma genesis). Fish can become a permanent part of the cancer investigator's armamentarium.

Further studies on fish tumors are warranted. It is astonishing that such primitive vertebrates have been neglected until recently in experimental cancerology.

75-000562 Ghittino, P. (Ist. Zooprofil. Sperim. Via Bologna, 148-10154 Torino, Italy) RILIEVI CLINICI E PATOLOGICI SU UN CASO DI CATARATTA VERMINOSA IN TROTELE IRIEE D'ALLEVAMENTO. [CLINICAL AND PATHOLOGICAL REMARKS ON A CASE OF WORM CATARACT IN FARMED RAINBOW TROUT YEARLINGS.] Riv. It. Piscic. Ittiop. 10 (2): 59-61. Apr.-May-June 1975. In Italian with English summ. SFA 20(4).

The author described a case of Worm Cataract (WC) in trout farmed in Italy. The fish were unusually pale and lethargic in the pond; on the hands, trout presented a whitish turbidity in both lenses that, microscopically, were strongly positive for larval /Diplostomum spathaceum/.

The author briefly proposed etio-pathogenetic interpretations of the case. The presence of larval trematode in trout lens should induce whitish opacity but not complete blindness. So fish tune on a whitish-milky environment and appear "pale".

Differential diagnosis of WC with other diseases that may involve fish lens, and also control measures of the parasitosis, were commented by the author.

75-000563 Hargens, A. R.; Perez, M. (Dep. Med., Univ. Calif. Vettrans Hosp., San Diego 92161) EDEMA IN SPAWNING SALMON. J. Fish. Res. Board Can. 32 (12): 2538-2541. Dec. 1975. In English with French summ. SFA 20(4).

Salmon develop edema during their spawning migration from the sea to fresh water. As measured by the wick technique, fluid pressure in both subcutaneous and peritoneal compartments rises from negative values at sea to positive values in rivers. Concomitantly, blood colloid osmotic pressure falls during the spawning migration. Some of the degenerative changes leading to the death of postspawning salmon probably result from the total-body edema herein described.

75-000564 John, S. E.; Nair, N. B. (Dep. Aquatic Biol. Fish., Univ. Kerala, Trivandrum-7, India) FUNCTIONAL MORPHOLOGY OF THE MOUTH TUBE OF /PSEUDOCYCNUS ARMATUS/--BASSET SMITH--A PARASITIC COPEPOD ON /INDOCYBIUM GUTTATUM/. Bol. Inst. Oceanogr. Univ. Oriente Cumana 12 (2): 23-27. Dec. 1973. In English with Spanish summ. SFA 20(4).

/Pseudocycnus armatus/ is a gill parasite of /Indocybium guttatum/. The conical mouth tube is formed by the apposition of the edges of the dorsal and ventral lips reinforced by a number of chitinous rods which are arranged in a regular pattern. A triangular lamina at the base of the mouth tube extends into the cephalothorax. The mandibles originate close to the base of the mouth tube. Each mandible is lodged in an external groove on the lateral side of the mouth tube, formed by the projecting edge of the ventral lip, overlapping the corresponding edge of the dorsal lip. These grooves are tentatively called the labial grooves. The distal ends of the labial grooves adjoin the mouth opening so that when the mandibles puncture a blood vessel the blood oozes out directly into the mouth tube. The mouth tube is formed of a thin cuticular wall, lined internally by a sparse reticulum of connective tissue. Muscle fibres are absent and so the mouth tube function only as a receptacle in which the host's blood accumulates before it is sucked into the oesophagus. The maxillary gland is either a modified excretory or salivary gland which appears to have taken on the important function of secreting an enzyme which prevents the coagulation of the host's blood during its retention in the mouth tube and subsequent passage through the very narrow lumen of the oesophagus. However it may be observed that in other blood feeding copepod parasites glands secreting anticoagulants do not seem to have been noticed.

75-000565 Milbrink, G. (Inst. Freshwater Res., Drottingholm, Sweden) POPULATION BIOLOGY OF THE CESTODE /CARYOPHYLLAEUS LATICEPS/ (PALLAS) IN BREEM, /ABRAMIS BRAMA/ (L.), AND THE FEEDING OF FISH ON OLIGOCHAETES. Rep. Inst. Freshwater Res. Drottingholm No. 54: 36-51. 1975. SFA 20(4).

The population biology of /Caryophyllaeus laticeps/ in bream was studied at Drottingholm in Lake Malaren over a period of three and a half years. The cycle of infection was found to have two definite peaks, one in the spring and one in the autumn. As far as the author knows, two peaks have never before been described for /C. laticeps/, only one single peak in the spring being earlier observed. Furthermore, newly infested specimens of /C. laticeps/ could be found in these bream at any time of the year. Under normal conditions records of infection by the parasite in the autumn and in the winter are otherwise very few in the literature. (From Auth. Summ.)

75-000566 Rucker, R. R. (NMFS, 2725 Montlake Blvd. East, Seattle, WA 98112) GAS-BUBBLE DISEASE: MORTALITIES OF COHO SALMON, /ONCORHYNCHUS KISTUCH/, IN WATER WITH CONSTANT TOTAL GAS PRESSURE AND DIFFERENT OXYGEN-NITROGEN RATIOS. NOAA Fish. Bull. 37 (4): 915-918. Oct. 1975. SFA 20(4).

Coho salmon fingerlings were subjected to a total gas pressure of 119 percent at 13.6 c with the O(2)/N(2) varying from 50 percent/138 percent to 229 percent/90 percent. The small fish (3.8 to 6 cm) were the most resistant and the larger fish (8 to 10 cm) the least resistant to gas-bubble disease at the gas concentrations used. A drastic decrease in lethal effect of individual ratios of O(2) to N(2) occurred between 159 percent O(2)/109 percent N(2) and 173 percent O(2)/105 percent N(2) at the same total gas pressure (119 percent). (Auth. Summ.)

75-000567 Russo, R. A. (East Bay Reg. Parks Dist., 11500 Skyline Blvd., Oakland, CA 94619) NOTES ON THE EXTERNAL PARASITES OF CALIFORNIA INSHORE SHARKS. Calif. Fish Game 61 (4): 228-232. Oct. 1975. SFA 20(4).

75-000568 Wobeser, G.; Smith, N. W. (Dep. Vet. Pathol., Univ. Saskatchewan, Saskatoon, SK S7N 0W0, Canada) PROLIFERATIVE BONE LESIONS IN LAKE WHITEFISH (/COREGONUS CLUPEAFORMIS/). J. Fish. Res. Board Can. 32 (11): 2065-2068. Nov. 1975. In English with French summ. SFA 20(4).

Tumor-like masses were found attached to the skeleton in three lake whitefish (/Coregonus clupeaformis/) captured in two different years from Redberry Lake, Saskatchewan. The masses were composed of fibrous and osseous tissue and resembled the condition "fibrous dysplasia of bone" as described in man. There was no evidence of other disease in these fish.

POLLUTION

75-000569 Antia, N. J.; Cheng, J. Y. (Fish. Mar. Serv., Vancouver Lab., Vancouver, BC V6T 1X2, Canada) CULTURE STUDIES ON THE EFFECTS FROM BORATE POLLUTION ON THE GROWTH OF MARINE PHYTOPLANKTERS. J. Fish. Res. Board Can. 32 (12): 2487-2494. Dec. 1975. In English with French summ. SFA 20(4).

The autotrophic growth of 19 species of marine phytoplankters, from 10 classes of algae, was tested on axenic cultures with boric acid

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additions of 0-100 mg/liter B to a nutrient-enriched, pH-controlled seawater medium. All the growth rates were virtually unaffected by the incorporation of 5-10 mg/liter B, while 26 percent of the species were strongly inhibited by 50 mg/liter B and this proportion was increased to 63 percent species inhibited at 100 mg/liter B. Several species required prolonged periods of adaptation before exponential growth with 50-100 mg/liter B. Both the adaptation period and the degree of inhibition were gradually mitigated on sequential transfer of certain species from lower to higher boron concentration. Such sequential transfer tests showed that the majority of initially inhibited species could recover good growth at 50 mg/liter B but not at 100 mg/liter B, which concentration appeared to be lethal to 37 percent of the species tested. These results predict that, in the absence of stress from nutrient deficiency and pH adversity, inorganic borate pollution would be facily tolerated by phytoplankton up to 10 mg/liter B; higher borate concentrations up to 100 mg/liter B are expected to cause species redistribution tending to favor growth of some forms by supressing that of others.

75-000570 Bowes, G. W.; Jonkel, C. J. (Calif. Water Resour. Contr. Board, Sacramento 95814) PRESENCE AND DISTRIBUTION OF POLYCHLORINATED BIPHENYLS (PCB) IN ARCTIC AND SUBARCTIC MARINE FOOD CHAINS. J. Fish. Res. Board Can. 32 (11): 2111-2123. Nov. 1975. In English with French summ. SFA 20(4).

Polychlorinated biphenyls (PCB), man-made industrial chemicals, have been identified in tissues of polar bears (*Ursus maritimus*), ringed (*Phoca hispida*) and square flipper (*Erignathus barbatus*) seals, and Arctic char (*Salvelinus alpinus*) of the Canadian arctic and subarctic. All tissues from each species examined contained these compounds. PCB content in tissue, both absolute and relative to the concentration of DDT (p,p'-DDE + p,p'-DDD + p,p'-DDT), generally increased from seals to adult polar bears to polar bear cubs and young. Polar bear milk contained high concentrations of PCB and is the most probable source of the high concentrations in polar bear cubs. Chromatograms revealed a greater accumulation of higher chlorinated PCB isomers in polar bears than in seals, their main food. Residue data suggest that polar bear subpopulations in the eastern Canadian arctic and subarctic have been exposed to higher levels of PCB and DDT than western subpopulations.

75-000571 Dickson, W. (Not. Swedish Environ. Prot. Board, Res. Lab., Drottningholm, Sweden) THE ACIDIFICATION OF SWEDISH LAKES. Rep. Inst. Freshwater Res. Drottningholm No. 54: 8-20. 1975. SFA 20(4).

The acidification affects thousands of Swedish low-buffered lakes. Many of these lakes are situated in virgin forests, in national parks and in mountain areas. According to the Government they were "not allowed to be polluted by any kind of matter". Some of them can be limed, but it is certain that the country as a whole is suffering through the loss of unpolluted water and much of the habitat for aquatic life. (Auth. Concl.)

75-000572 Feldman, M. H.; Cawlfeld, D. E.; Byram, K. V. (Lab. Serv. Br., Corvallis Environ. Res. Lab., Corvallis, OR 97330) ENVIRONMENTAL TRACE MATERIALS: COMPUTER COUPLED RADIOACTIVATION ANALYSIS. U.S. Environ. Prot. Agency, Ecol. Res. Ser. EPA-600/3-75-015. vi + 36p. Dec. 1975. SFA 20(4).

A neutron activation laboratory with computer coupled equipment and procedures was established. The power of the methodology for Environmental Trace Material Analysis was demonstrated by analyzing various materials and included quality control interlaboratory

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comparisons. Samples ranged from sewage treatment plant sludges and marine sediments to fresh waters containing very low concentrations of molybdenum, and ores and fertilizers containing cadmium.

75-000573 Kelly, T. M.; Jones, J. D.; Smith, G. R. (Great Lakes Resour. Manage. Program, Univ. Mich., Ann Arbor 41804) HISTORICAL CHANGES IN MERCURY CONTAMINATION IN MICHIGAN WALLEYES (/STIZOSTEDION VITREUM VITREUM/). J. Fish. Res. Board Can. 32 (10): 1745-1754. Oct. 1975. In English with French summ. SFA 20(4).

Mercury concentrations in Michigan walleyes (/Stizostedion vitreum vitreum/) are more variable among localities than between recent and historical samples within localities. Increases in mercury concentrations were noted in the recent populations of lakes Cadillac and Mitchell, Lake Gogebic, and western Lake Erie. Walleyes in four of seven localities showed no statistically significant increases in the level of mercury contamination over the past 40 yr. Mercury values over 0.5 ppm are common only on Isle Royale, in Saginaw Bay, and in western Lake Erie. Walleyes from Houghton Lake, Bear Lake, and lakes Cadillac and Mitchell show low levels of mercury contamination.

Methods for validly comparing preserved and fresh specimens were established by tests to determine the weight loss through dehydration in preservation. In 74 percent, alcohol, muscle tissue of medium to large walleyes dehydrates to about 70 percent of the fresh weight in the first year.

Mercury concentration in walleye muscle from recent and old museum collections is positively correlated with age and size. Considerable variation in concentration exists not only between geographic localities, but within populations, and even within subsamples of the same tissue.

75-000574 Milbrink, G.; Johansson, N. (Inst. Freshwater Res., Drottingholm, Sweden) SOME EFFECTS OF ACIDIFICATION ON ROE OF ROACH, /RUTILUS RUTILUS/ L., AND PERCH, /PERCA FLUVIATILIS/ L.--WITH SPECIAL REFERENCE TO THE AVAA LAKE SYSTEM IN EASTERN SWEDEN. Rep. Inst. Freshwater Res. Drottingholm No. 54: 52-62. 1975. SFA 20(4).

The lower limits of tolerance to acidification were studied for two of the most frequent freshwater fish in any Scandinavian waters, roach and perch. It has been convincingly demonstrated in the literature that the early development of most fish is particularly sensitive in this context. Accordingly, the impact of acidification was simultaneously tested on roe of roach and perch in the laboratory and in the field.

The lower limit of tolerance for roach turned out to be slightly above pH 5.5 both /in situ/ and /in vitro/. Similarly the lower limit for perch was close to pH 4.7. For comparison, the same lower limit for pike--pH 5.0--obtained in a similar way has also been included in the text (Johansson and Runn, in manuscript). The values obtained for these three fish are in good agreement with empirical results obtained in waters all over Scandinavia.

Fish may get acclimatized to acid conditions when exposed for a long time. In order to test the possible effects of acclimatization roach roe was brought from Lake Malaren to lakes in the Avaa Lake system to the south-east of Stockholm for comparison with indigenous roe. With reservation for a rather limited material the indigenous roe gave a better hatching success and thus revealed a lower limit of tolerance to acidification.

Over the last decade special attention has been paid to the acidification of waters in Western Scandinavia. We now know that even weakly buffered lakes in the eastern part of Sweden are threatened. The Avaa Lake system, chosen for the purpose of this study, is under the obvious impact of acidification. The fish fauna is under species

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reduction. Roach gradually disappear from the source lakes of the system and the remaining perch, if any, increase in size due to little competition in the search for food. According to available evidence the transparency has doubled since the 1940's and pH has decreased in the order of half a unit in the source lakes of the system. (Auth. Summ.)

75-000575 Nair, N. B.; Rajan, K. C. (Dep. Aquatic Biol. Fish., Univ. Kerala, Trivandrum, India) OBSERVATIONS ON THE EFFECT OF EFFLUENTS FROM A TITANIUM PLANT ON THE INTERSTITIAL FAUNA. Bol. Inst. Oceanogr. Univ. Oriente Cumana 13 (1-2): 107-124. Dec. 1974. In English with Spanish summ. SFA 20(4).

The effects of effluents discharged from a titanium factory on the interstitial fauna of a tropical sandy beach were investigated. The pollutants consisted of sulphuric acid, ferrous sulphate and in a small scale TiOSO_4 . The magnitude of environmental deterioration and the resultant effects on the sand microfauna were examined. Environmental factors such as beach morphology, grain size, tides, waves, currents, temperature, salinity, dissolved oxygen, nutrients, hydrogen ion concentration, and the nature of effluents were analysed and the seasonal occurrence and relative abundance of the interstitial fauna recorded. The nature of dispersal of pollutants on the beach and their effects on the microfauna are discussed.

75-000576 Nyman, L. (Inst. Freshwater Res., Drottingholm, Sweden) ALLELIC SELECTION IN A FISH (*GYMNOCEPHALUS CERNUA* (L.)) SUBJECTED TO HOTWATER EFFLUENTS. Rep. Inst. Freshwater Res. Drottingholm No. 54: 75-82. 1975. SFA 20(4).

Analyses of samples of ruff (*Gymnocephalus cernua* (L.)) subjected to the hotwater effluents of a nuclear power station (OKG) on the Baltic coast of Sweden have demonstrated changes in migratory patterns depending upon the genetic composition of certain individuals better adapted to the new environment. Thus gene frequency data indicated significant differences between fish attracted by hot water and those trying to avoid it. Also, the population immediately outside the outlet of the thermally influenced Hamnefjarden Bay was transformed genetically by immigrants from adjacent populations, and in one year the frequency of the most anodal allele has increased from 0.50 to 0.89 at this sampling point. Some biological implications of such artificial temperature changes causing allelic selection are discussed. (Auth. Summ.)

75-000577 Nyman, L. (Inst. Freshwater Res., Drottingholm, Sweden) BEHAVIOUR OF FISH INFLUENCED BY HOTWATER EFFLUENTS AS OBSERVED BY ULTRASONIC TRACKING. Rep. Inst. Freshwater Res. Drottingholm No. 54: 63-74. 1975. SFA 20(4).

To observe the influence of heated discharges from thermal power stations on fish behaviour ultrasonic tracking was employed.

Ide (*Leusiscus idus* (L.)) and silver eel (*Anguilla anguilla* (L.)) were studied off the nuclear power station at Oskarshamn (OKG) on the Swedish east coast, sea-run brown trout (*Salmo trutta* (L.)) and yellow eel were studied off Stenungsund thermal power station on the west coast of Sweden.

The tags were manufactured by Chipman Instruments (Madison, Wisconsin U.S.A.) and were both the standard type and those with thermistors incorporated for temperature determination. The hydrophone/sonic receiver employed were of Smith-Root make, namely SR-70-H/TA-25.

The three species do not display any atypical behaviour as a result of carrying stomach tags and tag shedding is not a great problem. Ide

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are attracted by hot water, at least in the autumn, and the duration of the attraction appears short. Net avoidance was also observed. Yellow eels are attracted by heated discharges in summer, and although silver eel were activated and attracted in winter at 7-10°C by a rising temperature gradient, there are indications that they are repelled in the late summer and autumn which is their principal migration period.

Sea-run brown trout are attracted by hot water when ambient sea temperatures do not exceed 15-16°C. In summer they avoid the heated area.

The direct approach of underwater telemetry to study the effects of elevated temperatures on fish behaviour has many advantages, including the fact that fish appear uninfluenced both by the internal tags and the tracking system. (Auth. Summ.)

75-000578 Olsson, M.; Jensen, S. (Swedish Mus. Nat. Hist., Res. Dep., Stockholm, Sweden) PIKE AS THE TEST ORGANISM FOR MERCURY, DDT AND PCB POLLUTION. A STUDY OF THE CONTAMINATION IN THE STOCKHOLM ARCHIPELAGO. Rep. Inst. Freshwater Res. Drottningholm No. 54: 83-106. 1975. SFA 20(4).

Pike has been shown to be a suitable organism for a study of the pollution pattern in an area contaminated by bioaccumulating substances. For the mercury levels, the weight of the individual fishes must be considered and the mercury level at a calculated standard weight has to be used when comparing different regions. For the DDT and PCB substances in the present material, the mean level of the samples can be used.

In the studied area, the levels of mercury and PCB decrease from Stockholm outwards in the archipelago. Local sources in the inner part of the archipelago, and for PCB, loss from antifouling paint also, seem to be mainly responsible for the pollution. Only in the outer parts of the southern area are natural low mercury levels found. DDE and DDD also decrease and sDDT seems to decrease in the same manner as for mercury and PCB. The DDT levels do not decrease outwards. Thus the ratio DDE/sDDT is highest in the inner part of the archipelago and this is also true for DDD/sDDT. DDT/sDDT, on the other hand, is highest in the outer part. The most probable explanation for this condition is that the archipelago is or has been contaminated from local sources in the inner parts. In addition, in view of the fact that DDT levels did not decrease in the outer parts and that the ratio DDT/sDDT increased significantly, contamination of the outermost parts of the archipelago from the Baltic seems certain.

High levels of mercury, DDT and PCB substances in pike from one of two island lakes in the prevailing wind direction from Stockholm indicate airborne fallout. Lower levels are recorded in a neighbouring lake. The differences in the levels between the lake may be explained by a higher biomass and a more rapid water exchange in the lake with lower values. (Auth. Concl.)

75-000579 Polisois, G.; Tessier, A.; Campbell, P. G. C.; Villeneuve, J. P. (Quebec Dep. Nat. Resour., Ste-Foy, PQ G1V 4C7, Canada) DEGRADATION OF PHENOLIC COMPOUNDS DOWNSTREAM FROM A PETROLEUM REFINERY COMPLEX. J. Fish. Res. Board Can. 32 (11): 2125-2131. Nov. 1975. In English with French summ. SFA 20(4).

Measurements downstream from refinery outfalls in the region of Montreal East have shown that, under favorable temperature conditions, the concentration of phenolic substances in the river water rapidly diminishes with distance from the refineries. Mass balance calculations at different transverse sections show that this decrease in concentration cannot be attributed to dilution only. Laboratory experiments performed on river water samples demonstrate the effects

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of water temperature and sterilization on the rate of phenol breakdown. Results support the idea that biodegradation is responsible for the self-purification of phenolics in the St. Lawrence River.

FISH KILLS

75-000580 Casselman, J. M.; Harvey, H. H. (Dep. Zool., Univ. Toronto, 25 Harbord St., Toronto 5, ON, Canada) SELECTIVE FISH MORTALITY RESULTING FROM LOW WINTER OXYGEN. Verh. Int. Verein. Limnol. 19: 2418-2429. Nov. 1975. SFA 20(4).

Length, age, growth rate, and sex ratio of fish, especially pike /*Esox lucius*/, that died or survived winterkill in two small lakes on Manitoulin Island, Ontario, were examined. Cleithra were used to assess age and growth and to determine the length of the winterkilled pike. A high percentage of pike in the smaller lake succumbed and extensive netting of the population before and after the partial winterkill substantiated selective mortality. No pike longer than 392 mm FL was captured alive after winterkill although 34.2 percent of the dead fish exceeded this length. Average length of pike captured in the spring after winterkill was significantly smaller, 321 ± 12 mm, than that of pike found dead, 393 ± 22 mm, or captured alive during the preceding winter, 382 ± 36 mm. No pike older than 2⁺ (second annulus just forming) was captured immediately after winterkill, although 31.3 percent of the fish that succumbed exceeded this age. Average age of pike captured in the spring, 195 ± 0.1 years, was significantly less than that of pike found dead, 2.5 ± 0.3 years, or captured alive during the winter, 2.1 ± 0.5 years. Slower-growing pike survived whereas faster-growing individuals succumbed. The difference was significant for females of both surviving age groups. Significantly more males survived and females succumbed. Selection by critical oxygen concentrations which resulted in partial winterkill is discussed in relation to metabolic rate, maturity, and physiological tolerance.

75-000581 Knudson, K.; Belaire, C. E. (Tex. Parks Wildl. Dep., P.O. Box 8, Seabrook 77586) CAUSES AND PROBABLE CORRECTIVES FOR OXYGEN DEPLETION FISH KILLS IN THE DICKINSON BAYOU ESTUARY: A FIELD STUDY AND SIMPLIFIED ALGAL ASSAY. Contrib. Mar. Sci. 19: 37-48. Aug. 1975. SFA 20(4).

Frequent oxygen depletion fish kills, caused by dense algal blooms, have occurred during summers in the six-kilometer portion of Dickinson Bayou directly upstream from two sewage treatment plants. These plants are the major contributors of wastes to the bayou. During summer periods of low freshwater inflow, the treatment plant effluents are carried upstream by tidal action, causing dense algal blooms; algal density is much less above tidal influence and downstream from the plant outfalls. Algal assays demonstrated that if the plants employed chemical coagulation to remove phosphorus, the summer algal densities in the critical six-kilometer portion of the bayou would be reduced to concentrations corresponding to, or less than, the levels found in the rest of the bayou. Such treatment would thereby reduce the probability of summer fish kills.

TOXICOLOGY; BIOASSAYS

75-000582 Argyle, R. L.; Williams, G. C.; Daniel, C. E. (U.S. FWS, Great Lakes Fish. Lab., Ann Arbor, MI 48107) DIELDRIN IN THE DIET OF CHANNEL CATFISH (/ICTALURUS PUNCTATUS/): UPTAKE AND EFFECT ON GROWTH. J. Fish. Res. Board Can. 32 (11): 2197-2204. Nov. 1975. In English with French summ. SFA 20(4).

Fingerling channel catfish (/Ictalurus punctatus/) were given diets containing 0, 0.4, 0.8, or 4.0 ug dieldrin/g of food (dry weight) for 210 days, followed by a dieldrin-free diet for 56 days. Catfish receiving 4.0 ug dieldrin/g of food gained about 17 percent less weight than the control fish in 210 days and about 35 percent less weight during the last 126 days of the 210-day period. No growth differences were attributable to the ingestion of 0.4 or 0.8 ug dieldrin/g of feed. Mortality during the experiment was not appreciable.

Dieldrin accumulations were characterized by an immediate rapid rise of residue levels in the tissues, followed by a period during which concentrations were relatively stable. Residues in tissues decreased rapidly after dieldrin was withdrawn from the diet. Dieldrin half-life was 9.6 days (mean for the three groups).

Theoretical residue concentrations calculated from the growth, feeding, and half-life data were similar to the empirical concentrations, although the theoretical values were consistently the higher. The recoverable concentration accounted for 25.7 percent (mean of the three treatments) of the theoretical concentration.

75-000583 Atchison, G. J.; Johnson, H. E. (Bionucleon. Dep., Purdue Univ., West Lafayette, IN 47907) THE DEGRADATION OF DDT IN BROOK TROUT EGGS AND FRY. Tran. Am. Fish. Soc. 104 (4): 782-784. Oct. 1975. SFA 20(4).

Adult brook trout (/Salvelinus fontinalis/) were fed p,p'-DDT-³H; eggs obtained from these fish were fertilized, and incubated; and the developmental stages were analyzed for the degree of metabolism of the DDT. About 35 percent of the p,p'-DDT-³H in the eggs at the time of fertilization was converted to p,p'-DDE-³H and p,p'-DDD-³H by the time of yolk depletion in the fry.

75-000584 Bahner, L. H.; Craft, C. D.; Nimmo, D. R. (U.S. EPA, Gulf Breeze Environ. Res. Lab., Sabine Island, Gulf Breeze, FL 32561) A SALTWATER FLOW-THROUGH BIOASSAY METHOD WITH CONTROLLED TEMPERATURE AND SALINITY. Prog. Fish-Cult. 37 (3): 126-129. July 1975. SFA 20(4).

A method is described for flowing water bioassays which allows control of temperature and salinity, thus facilitating replication of test conditions and studies of toxicant-environmental stress interaction. The flow-through system described has been used with the pink shrimp, /Penaeus duorarum/, but, with minor modifications, is adaptable to a variety of estuarine and marine macroinvertebrates and fishes. The cost of the flow-through system for laboratories having flowing seawater is approximately \$1,500, an amount within many research budgets.

75-000585 Blason, D. R.; Blau, G. E.; Alexander, H. C.; Neely, W. B. (Environ. Sci. Res., The Dow Chem. Co., Midland, MI 48640) BIOCONCENTRATION OF 2,2',4,4'-TETRACHLOROBIPHENYL IN RAINBOW TROUT AS MEASURED BY AN ACCELERATED TEST. Trans. Am. Fish. Soc. 104 (4): 785-792. Oct. 1975. SFA 20(4).

Some hydrophobic chemicals may reach plateau levels in fish only after several months of continuous exposure. Therefore, an accelerated test procedure, based on kinetics, was developed using an isomer of PCB's (polychlorinated biphenyls): 2,2',4,4'-tetrachlorobiphenyl. The rates of uptake and clearance of 2,2',4,4'-tetrachlorobiphenyl were determined by analysis of rainbow trout (*Salmo gairdneri*/Richardson).

These trout were exposed to 1.6 and 9.0 ug/liter for five days and then transferred to fresh water. A nonlinear regression analysis was used to estimate the rate constants for uptake and clearance, and the bioconcentration factor at steady-state was calculated from the rate constants. For 2,2',4,4'-tetrachlorobiphenyl, the bioconcentration factor at steady-state was 9550 ± 1610 in trout muscle.

The accuracy of the bioconcentration factor determined by this accelerated test procedure was compared with experimental observations in a 42-day test. The concentration of 2,2',4,4'-tetrachlorobiphenyl in trout muscle was 82 ± 20 ug/g after 42 days continuous exposure to 14 ug/liter. This was in good agreement with 92 ± 18 ug/g predicted from the accelerated procedure. The 42-day level was about 43 percent of the theoretical steady-state for 2,2',4,4'-tetrachlorobiphenyl in trout muscle. Therefore, this accelerated procedure can provide information about the potential of a chemical to bioconcentrate in fish in a much shorter period of time than can be provided by previously described methods.

75-000586 Brown, D. A.; McLeay, D. J. (Div. Appl. Biol., B.C. Research, Vancouver, BC V6S 2L2, Canada) EFFECT OF BLEACHED KRAFT MILL EFFLUENT ON THE SURVIVAL OF STARVED JUVENILE COHO SALMON (*ONCORHYNCHUS KISTUCH*). J. Fish. Res. Board Can. 32 (12): 2528-2530. Dec. 1975. In English with French summ. SFA 20(4).

Starved coho salmon (*Oncorhynchus kisutch*) fingerlings were exposed to "sublethal" concentrations of neutralized bleached kraft mill effluent (BKME). Time to death was similar in the control group, in fish continuously exposed to BKME concentrations equivalent to 0.05-0.4 of the samples' 96-h LC50 values, and in fish exposed to a treated (foam-stripped) portion of the samples at a volume equivalent to 0.7 LC50 for untreated effluent. Time to death decreased progressively in groups exposed to effluent concentrations higher than 0.4 of the 96-h LC50.

75-000587 Chernoff, B. (Dep. Biol. Inst. Mar. Sci., Adelphi Univ., Garden City, NY 11530) A METHOD FOR WET DIGESTION OF FISH TISSUE FOR HEAVY METAL ANALYSES. Trans Am. Fish. Soc. 104 (4): 803-804. Oct. 1975. SFA 20(4).

A procedure for wet digestion of fish tissue that utilizes nitric, sulfuric, and perchloric acids can digest 1 g of fish tissue in approximately 45 minutes. This procedure allows for the preparation of large numbers of samples and is suitable for the analysis of Cd, Cu, Mn, Zn, and probably other heavy metals by atomic absorption spectroscopy. The method eliminates the problem of clogging of the aspirator tube of the atomic absorption unit.

75-000588 Clarke, R. McV. (Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB, Canada) A SUMMARY OF TOXICITY INFORMATION FOR MAJOR EFFLUENT COMPONENTS FROM INORGANIC CHEMICAL INDUSTRIES. Environ. Can. Fish. Mar. Serv. Tech. Rep. Ser. No: CEN/T-74-9. v + 27p. 1974. SFA 20 (4).

Toxicity information available in the literature is summarized, in tabular form, for major components in effluents from Inorganic Chemical Industries. The information presented for each component is the lowest and highest recorded levels that were lethal to fishes and to invertebrates and the lowest recorded level that had a sublethal effect on aquatic biota. Additional comments indicate the major factors which affect the toxicity of each component, or other deleterious effects of the component. Suggested water quality criteria data also are presented for most components.

75-000589 Eberhardt, L. L. (Battelle Mem. Inst., Richland, WA 99352) SOME METHODOLOGY FOR APPRAISING CONTAMINANTS IN AQUATIC SYSTEMS. J. Fish. Res. Board Can. 32 (10): 1852-1859. Oct. 1975. In English with French summ. SFA 20 (4).

Kinetic models for uptake and retention of various contaminants by aquatic biota are recommended as useful means of summarizing and intercomparing laboratory studies, and as essential tools in analyzing field data. Some simple models are fitted to laboratory data on the uptake and retention of DDT and dieldrin by fish. The well-known relation between metabolic rate and body size is used to appraise data and concentrations of DDT, PCBs, and mercury in fish taken from lakes and oceans. Evidence suggests that uptake and retention experiments performed on small fish give very different results from those expected on individuals important in sports or commercial fisheries.

75-000590 Eisler, R.; Kissil, G. W. (U.S. EPA, Natl. Mar. Water Qual. Lab., Narragansett, RI 02882) TOXICITIES OF CRUDE OILS AND OIL-DISPERSANT MIXTURES TO JUVENILE RABBITFISH, *SIGANUS RIVULATUS*. Trans. Am. Fish. Soc. 104 (3): 571-578. July 1975. SFA 20 (4).

Toxicities were determined for two crude oils, one from the Persian Gulf (Iran) and one from the Sinai Peninsula (Gulf of Suez), to rabbitfish, *Siganus rivulatus*, an economically important species of teleost from the Red Sea. Also tested for toxicity were ST 5, a chemical oil dispersant, and oil-ST 5 mixtures in the ratio 10:1 vol/vol. Static tests conducted in small (3-liter) jars at 41 ‰ salinity and 23 C produced LC(50) (168 h) values of 0.74 ml/liter for Iranian crude, 14.5 ml/liter for Sinai crude, and 0.010 ml/liter for ST 5; LC(50) values for oil-ST 5 mixtures reflected biocidal properties of ST 5 alone. Iranian oil became less toxic with increasing time in seawater over a period of 168 hours; the reverse was observed for Sinai crude. ST 5 exhibited a dramatic reduction in lethality after 2 hours in the assay medium. The most toxic component tested of Iranian crude was the lowest-boiling fraction; with Sinai crude it was the highest-boiling fraction; with ST 5 the volatile surfactant component accounted for almost all deaths. Liver enlargement in rabbitfish was linked with exposure to comparatively high concentrations of crude oil. High sublethal levels of ST 5 caused reductions in blood hematocrit. Rabbitfish survival at a given petrochemical concentration was highest at intermediate salinities of 30-50 ‰ in the salinity range tested of 20 to 60 ‰. Rabbitfish were more resistant to crudes and oil-dispersant mixtures in continuous flow bioassays conducted in large tanks than in static jar bioassays. Tank tests also suggested that mortalities were higher among toxicant-stressed fish confined 0.2 to 1.0 meters from the surface than among fish held 1.0 to 1.8 m from the surface.

75-000591 Emerson, K.; Russo, R. C.; Lund, R. E.; Thurston, R. V. (Thurston, R. V.: Dep. Chem., Mont. State Univ., Bozeman 59715) AQUEOUS AMMONIA EQUILIBRIUM CALCULATIONS: EFFECT OF PH AND TEMPERATURE. J. Fish. Res. Board Can. 32 (12): 2379-2383. Dec. 1975. In English with French summ. SFA 20(4).

The toxicity of ammonia to fishes has been attributed to the un-ionized ammonia chemical species present in aqueous solution. Because the percent of total ammonia present as un-ionized ammonia (NH_3) is so dependent upon pH and temperature, and exact understanding of the aqueous ammonia equilibrium is important for toxicity studies. A critical evaluation of the literature data on the ammonia-water equilibrium system has been carried out. Results of calculations of values of $\text{pK}(\text{a})$ at different temperatures and of percent of NH_3 in aqueous ammonia solutions of zero salinity as a function of pH and temperature are presented.

75-000592 Eymann, L. D.; Gehrs, C. W.; Beauchamp, J. J. (Environ. Sci. Div., Oak Ridge Natl. Lab., Oak Ridge, TN 37830) SUBLETHAL EFFECT OF 5-CHLOROURACIL ON CARP (*CYPRINUS CARPIO*) LARVAE. J. Fish. Res. Board Can. 32 (11): 2227-2229. Nov. 1975. In English with French summ. SFA 20(4).

The sublethal effects of 5-chlorouracil, expressed as gross anatomical malformations, on newly hatched carp (*Cyprinus carpio*) larvae are presented. The percent malformed of those hatched was 1.2 at 0.5 ppm, 2.1 at 1.0 ppm, 2.7 at 5.0 ppm, and 4.3 at 10 ppm. Both at least-squares fit of a hyperbolic model and a linear-regression fit are used to describe the response. The malformations are an incremental effect of exposure to a toxicant which should be considered in addition to egg mortality in assessing the effect of environmental toxicants on populations.

75-000593 Flannagan, J. F. (Freshwater Inst., 501 University Crescent, Winnipeg, MB R3T 2N6, Canada) FIELD AND LABORATORY STUDIES OF THE EFFECT OF EXPOSURE TO FENITROTHION ON FRESHWATER AQUATIC INVERTEBRATES. Manit. Ecol. 7: 15-25. 1973. SFA 20(4).

Drift and Ekman grab samples were taken to determine the effect upon stream invertebrates of an aerial application of fenitrothion at 4 oz a.i./acre to a spruce forest. Laboratory studies were carried out in conjunction with the field program to investigate the lethal and delayed lethal effects of this chemical. In Pine Creek, Manitoba, the site of the experimental treatment, a large increase in drift of the most common animals was recorded immediately following the spray, both at a station within the spray area and at a downstream station. No related decreased in standing crop were recorded possibly due to recolonisation from upstream or from eggs, or because the chemical apparently never deeply penetrated the sediments. Laboratory tests indicate that there is both an immediate and a delayed lethality confirming previous observations by other authors. It is concluded that spraying of a whole prairie stream system could well have disastrous effects on the invertebrate population.

75-000594 Frederick, L. L. (Cent. Great Lakes Stud., Univ. Wis., Milwaukee 53201) COMPARATIVE UPTAKE OF A POLYCHLORINATED BIPHENYL AND DIELDRIN BY THE WHITE SUCKER (/CATOSTOMUS COMMERSONI/). J. Fish. Res. Board Can. 32 (10): 1705-1709. Oct. 1975. In English with French summ. SFA 20(4).

White suckers (/Catostomus commersoni/) accumulated the PCB Aroclor 1232 and dieldrin from water at approximately the same rate. However, they accumulated higher PCB levels than dieldrin levels when exposed to equivalent concentrations of these substances. The uptake pattern of Aroclor 1232 components on a whole fish basis and in gill and intestinal tissue was similar to Aroclor 1232 components to which the fish were exposed. The presence of additional components having short chromatographic retention times was observed in liver, brain, and kidney tissues in fish exposed only to Aroclor 1232.

75-000595 Grothe, D. R.; Eaton, J. W. (WAPORA Inc., 6900 Wisconsin Ave., N.W., Washington, DC 20015) CHLORINE-INDUCED MORTALITY IN FISH. Trans. Am. Fish. Soc. 104 (4): 800-802. Oct. 1975. SFA 20(4).

Chlorine and chlorine-ammonia compounds have been reported to be toxic to various species of freshwater fish. We have found that the basis of this toxicity in at least one species is the oxidation of hemoglobin to methemoglobin, producing death of the fish due to anoxia.

75-000596 Hansen, D. J.; Schimmel, S. C.; Forester, J. (U.S. EPA, Gulf Breeze Environ. Res. Lab., Sabine Island, Gulf Breeze, FL 32561) EFFECTS OF AROCLOR 1016 ON EMBRYOS, FRY, JUVENILES, AND ADULTS OF SHEEPSHEAD MINNOWS (/CYPRINODON VARIEGATUS/). Trans. Am. Fish. Soc. 104 (3): 584-588. July 1975. SFA 20(4).

We investigated the toxicity of Aroclor 1016 to, and uptake by, fry and juvenile and adult sheepshead minnows (/Cyprinodon variegatus/) in intermittent-flow bioassays lasting 28 days. Survival of eggs, of fry hatched from them, and of juvenile and adult fish apparently was not affected by 0.1, 0.32, 1.0, 3.2, or 10 ug/liter of Aroclor 1016 added to aquaria, but 32 and 100 ug/liter killed newly hatched fry and juvenile and adult fish. Sheepshead minnows accumulated the chemical in proportion to its concentration in the test water. Fry contained 2,500 to 8,100 X the concentration of Aroclor 1016 added to the test water, adults 4,700 to 14,000 X, and juveniles 10,000 to 34,000 X. As much as 77 ug/g of Aroclor 1016 in eggs from exposed adults apparently did not affect survival of embryos and fry.

75-000597 Hodson, P. V. (Great Lakes Biolimnol. Lab., Can. Cent. Inland Waters, Burlington, ON L7R 4A6, Canada) ZINC UPTAKE BY ATLANTIC SALMON (/SALMO SALAR/) EXPOSED TO A LETHAL CONCENTRATION OF ZINC AT 3, 11, AND 19 C. J. Fish. Res. Board Can. 32 (12): 2552-2556. Dec. 1975. In English with French summ. SFA 20(4).

Atlantic salmon (/Salmo salar/) acclimated to 3, 11, and 19 C took up high concentrations of zinc in gill tissues during exposures to a nominal 14 mg/liter of zinc. The rate of zinc uptake, as shown by ^{65}Zn tracer, increased from a minimum at 3 C to a maximum at 19 C. In fish killed by zinc exposure, zinc concentrations in gills were highest at 19 C and lowest at 3 and 11 C.

75-000598 Hogan, J. W.; Brauhn, J. L. (U.S. Fish-Pesticide Res. Lab., Columbia, MO 65201) ABNORMAL RAINBOW TROUT FRY FROM EGGS CONTAINING HIGH RESIDUES OF A PCB (AROCIOR 1242). Prog. Fish-Cult. 37 (4): 229-230. Oct. 1975. SFA 20(4).

Rainbow trout (*Salmo gairdneri*) fry from eggs containing 2.7 ug/g of Aroclor 1242 (PCB) and 0.09 ug/g of DDT complex had 75 percent cumulative mortality 30 days after hatching. In five other groups of less contaminated eggs, 10-28 percent mortality was noted 30 days after hatching. About 60-70 percent of the fry resulting from the highly contaminated eggs were deformed. Teratism is described.

75-000599 Latimer, D. L.; Brooks, A. S.; Beeton, A. M. (Cent. Great Lakes Stud., Univ. Wis., Milwaukee 53201) TOXICITY OF 30-MINUTE EXPOSURES OF RESIDUAL CHLORINE TO THE COPEPODS *LIMNOCALANUS MACRURUS*/ AND *CYCLOPS BICUSPIDATUS THOMASI*/. J. Fish. Res. Board Can. 32 (12): 2495-2501. Dec. 1975. In English with French summ. SFA 20(4).

The intermittent chlorination of power plant cooling waters often results in the appearance of residual chlorine in the receiving waters. Laboratory bioassays were conducted at 5, 10, 15, and 20 C to determine the toxicity of residual chlorine exposures of 30 min to the copepods *Limnocalanus macrurus*/ and *Cyclops bicuspidatus thomasi*/. The 30-min TL-50 was 1.54 mg/liter for *L. macrurus*/ at both 5 and 10 C. For *C. b. thomasi*/, the 30-min TL-50 values for exposures at 10, 15, and 20 C were 14.68, 15.61, and 5.76 mg/liter, respectively. The concentrations of residual chlorine causing 5 percent mortality (30-min TL-5) were used to predict "safe" levels for 30-min exposures. The predicted "safe" concentrations were 0.9 mg/liter for *L. macrurus*/ and 0.5 mg/liter for *C. b. thomasi*/. These concentrations roughly coincide with the maximal chlorine levels characteristic of most power plant effluents.

75-000600 Lawrence, M.; Scherer, E. (Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB, Canada) BEHAVIOURAL RESPONSES OF WHITEFISH AND RAINBOW TROUT TO DRILLING FLUIDS. Environ. Can. Fish. Mar. Serv. Tech. Rep. No. 502. iv + 47p. 1974. In English with French summ. SFA 20(4).

Behavioural responses of whitefish (*Coregonus clupeaformis*) and rainbow trout (*Salmo gairdneri*) to drilling mud (1 to 1000 ul/l) and its supernatant fraction (55 to 10,000 ul/l) were tested in laboratory experiments. Experiments were run under infrared as well as under visible light, to separate photically from chemically elicited responses.

Four response parameters were recorded and analysed: (1) percent test time spent in pure compared to contaminated water, (2) effect of contact with contaminant on swimming speed, turning rate, and frequency of movements across the centerline of the test chamber (boundary between pure and contaminated water), (3) extent of penetration by fish into pure vs contaminated water, (4) time spent at the end walls of the pure vs contaminated water side.

Conclusions on preference or avoidance are derived from these behavioural elements. The results are discussed with regard to LC50 values of drilling fluids.

75-000601 Leach, J. M.; Thakore, A. N.; Manville, J. F. (Div. Appl. Biol., B.C. Research, Vancouver, BC V6S 2L5, Canada) ACUTE TOXICITY TO JUVENILE RAINBOW TROUT (*SALMO GAIRDNERI*) OF NATURALLY OCCURRING INSECT JUVENILE HORMONE ANALOGUES. J. Fish. Res. Board Can. 32 (12): 2556-2559. Dec. 1975. In English with French summ. SFA 20(4).

Median lethal concentrations (LC50) of four insect juvenile hormone analogues (IJHA) for juvenile rainbow trout (*Salmo gairdneri*) were measured in bioassays with 4-h solution renewal. The most toxic compound tested was delta to the 4'-dehydrojuvabione, with a 48-h LC50 of 1.4 mg/liter and an estimated 96-h LC50 of approximately 0.8 mg/liter. Juvabione, epimeric mixtures of dihydrojuvabiones, and epimeric mixtures of juvabiols had 96-h LC50's of 1.5, 1.8, and 2.0 mg/liter, respectively. All fish, including those that survived for 96 h, became lethargic soon after exposure to solutions of the IJHA, and their skins darkened. The toxicants were unstable in aqueous solution.

75-000602 Lockhart, W. L.; Metner, D. A.; Grift, N. (Freshwater Inst., 501 University Crescent, Winnipeg, MB R3T 2N6, Canada) BIOCHEMICAL AND RESIDUE STUDIES ON RAINBOW TROUT (*SALMO GAIRDNERI*) FOLLOWING FIELD AND LABORATORY EXPOSURES TO FENITROTHION. Manit. Ecol. 7: 26-36. 1973. SFA 20(4).

Fenitrothion residues and several biochemical parameters were determined in yearling rainbow trout caged in a stream during aerial application of fenitrothion (0,0-dimethyl-0-(4-nitro-m-tolyl) phosphorothioate) at four ounces per acre. Samples of fish were taken one and four days after spraying and whole body residue concentrations averaged 0.44 and 0.63 ug/g on the first day after treatment; however, by the fourth day only 3 of 22 fish still contained measurable amounts. Biochemical measurements on treated fish were compared with other fish held upstream from the spray plot and no treatment effects were detected at a probability level of 0.05. Laboratory studies confirmed a lack of effect on serum chemistry and showed that the pesticide was distributed to internal organs.

75-000603 Marking, L. L.; Bills, T. D. (Fish Contr. Lab., P.O. Box 862, LaCrosse, WI 54601) TOXICITY OF POTASSIUM PERMANGANATE TO FISH AND ITS EFFECTIVENESS FOR DETOXIFYING ANTIMYCIN. Trans. Am. Fish. Soc. 104 (3): 579-583. July 1975. SFA 20(4).

The 96-h LC(50)'s for potassium permanganate (KMnO_4) ranged from 0.750 mg/liter with channel catfish, *Ictalurus punctatus*, to 3.60 mg/liter with goldfish, *Carassius auratus*, in laboratory tests. The toxicity of KMnO_4 to fish is greatest in water of lower temperatures, in harder water, or in higher pH water, KMnO_4 is effective for detoxifying the fish toxicant antimycin in laboratory waters of pH 6.5 to 9.5. The half-life for antimycin exposed to 1.0 mg/liter of KMnO_4 ranges from 7 to 11 minutes in the different pH waters at 12 C.

75-000604 McLeay, D. J. (Div. Appl. Biol., B.C. Research, Vancouver, BC V6S 2L2, Canada) SENSITIVITY OF BLOOD CELL COUNTS IN JUVENILE COHO SALMON (*ONCORHYNCHUS KISUTCH*) TO STRESSORS INCLUDING SUBLETHAL CONCENTRATIONS OF PULPHILL EFFLUENT AND ZINC. J. Fish. Res. Board Can. 32 (12): 2357-2364. Dec. 1975. In English with French summ. SFA 20(4).

Transfer of fish from optimal to high-temperature, crowded holding conditions decreased white blood cell-thrombocyte (WBC-T) counts markedly on 12-96-h exposure. Red blood cell (RBC) counts were increased only slightly at 12 and 48 h. During 28 days acclimatization following transfer to simulated stream compartments, WBC-T counts returned to stock values within 2-4 days, following an initial

75-000604 CONTINUED

decline. RBC counts were not altered appreciably.

The decline in WBC-T counts of acclimatized fish to a high sublethal concentration of pulp mill effluent was greatest at 24 h. Mean RBC counts were decreased over 24-96 h, but differences were significant at 24 h only. In acclimatized fish exposed to pulp mill effluent, WBC-T counts were decreased (P less than 0.001) at concentrations between 0.2 and 0.9 of the 96-h LC50. A 24-h exposure to 15 percent vol/vol of this effluent had considerably less effect on the WBC-T count when the effluent had been detoxified by foam fractionation.

Under similar experimental conditions, exposure to sublethal levels of zinc depressed mean WBC-T counts proportional to concentration, although differences were only significant at 0.5 LC50 and greater, RBC counts were unchanged.

The WBC-T response provides a reasonably rapid and sensitive method for measuring stressful levels of pulp mill effluents to salmon. Declines in WBC-T counts are attributable to reduced numbers of circulating small lymphocytes, which could result in decreased resistance of stressed fishes to disease.

75-000605 Meyerhoff, R. D. (NMFS, Tiburon Lab., Tiburon, CA 94920) ACUTE TOXICITY OF BENZENE, A COMPONENT OF CRUDE OIL, TO JUVENILE STRIPED BASS (*MORONE SAXATILIS*). J. Fish. Res. Board Can. 32 (10): 1864-1866. Oct. 1975. In English with French summ. SFA 20(4).

As the biological effects of the volatile aromatic compounds in crude oil are not well documented, a systematic examination of these compounds was initiated at the National Marine Fisheries Service at Tiburon. One of the major constituents of these aromatic compounds is benzene. The acute toxicity of benzene to 1.5 ± 0.5 G juvenile striped bass (*Morone saxatilis*) was studied in a continuous flow laboratory bioassay system. At 17.4 C and 29 ppt salinity, the lethal threshold concentration and the 96-h LC50 for benzene were 10.9 ul/liter. The 95 percent confidence interval was 10.9 ± 0.2 ul/liter and the probit line slope, "S," was 1.1. Possible toxic mechanisms are discussed.

75-000606 Middaugh, D. P.; Davis, W. R.; Yoakum, R. L. (U.S. EPA, Box 368, John's Island, SC 29455) THE RESPONSE OF LARVAL FISH, *LEIOSTOMUS XANTHURUS*, TO ENVIRONMENTAL STRESS FOLLOWING SUBLETHAL CADMIUM EXPOSURE. Contrib. Mar. Sci. 19: 13-19. Aug. 1975. SFA 20(4).

The toxicity of cadmium to larval fish, *Leiostomus xanthurus*, was studied. An incipient LC(50) concentration of approximately 0.2-0.3 mg/l cadmium was first estimated. Subsequent short-term sublethal tests were conducted to determine the relationship of cadmium exposure and accumulated whole body residues of the metal on the response of larvae to thermal stress and low dissolved oxygen. Results of this study indicated a significant decrease ($\alpha = 0.05$, t-Test) in the critical thermal maximum (CTM) for larvae exposed to 0.5 and 0.8 mg/l cadmium for 96 hours at 20C. Significant decreases ($\alpha = 0.05$, $/x/2$) in survival of larvae subjected to a dissolved oxygen (DO) level of 1.6 mg--l after exposure to 0.5 and 0.8 mg/l cadmium were also observed.

75-000607 Nowak, S. H. (Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB, Canada) A SOLID STATE TEMPERATURE CONTROLLER WITH HEATING AND COOLING CONTROL. Environ. Can. Fish. Mar. Serv. Tech. Rep. No. 195. iii + 16p. 1974. In English with French summ. SFA 20(4).

An inexpensive solid state on-off temperature controller is described which has for 2-1/2 years reliably maintained set point water temperatures to $\pm 0.1^{\circ}\text{C}$ in biological acclimation and exposure systems. A 500 watt heating load is controlled without using relays. Cooling is provided by the passage of cold water, regulated by a solenoid valve, through a stainless steel coil. A novel SCR flip-flop is used to alternately control heating and cooling.

75-000608 Olson, L. E.; Marking, L. L. (Fish. Contr. Lab., P.O. Box 862, La Crosse, WI 54601) TOXICITY OF FOUR TOXICANTS TO GREEN EGGS OF SALMONIDS. Prog. Fish-Cult. 37 (3): 143-147. July 1975. SFA 20(4).

The acute toxicity was determined for four toxicants against green eggs of coho salmon (*Oncorhynchus kisutch*), chinook salmon (*Oncorhynchus tshawytscha*), brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), and lake trout (*Salvelinus namaycush*) in waters of various hardnesses at 12 degrees C. The toxicants and the 96-h LC(50)'s in soft water (40-44 mg/liter as CaCO_3) were as follows: TFM (lampricide), 0.570 to 3.47 mg/liter against five species; Bay 73 (lampricide), 0.0824 to 0.113 mg/liter against four species; and antimycin and Noxfish (fish toxicants), greater than 10.0 ug/liter and 3.40 mg/liter, respectively, against brook trout. In waters of similar hardness, eggs were more resistant than fingerlings of the same species to Bay 73, antimycin, and Noxfish, and the two life stages were about equally resistant to TFM.

75-000609 Penrose, W. R. (Fish. Mar. Serv., Biol. Stn., St. John's, NF A1C 1A1, Canada) BIOSYNTHESIS OF ORGANIC ARSENIC COMPOUNDS IN BROWN TROUT (*SALMO TRUTTA*). J. Fish. Res. Board Can. 32 (12): 2385-2390. Dec. 1975. In English with French summ. SFA 20(4).

Radioactive, inorganic arsenic was administered to brown trout (*Salmo trutta*) orally and by intramuscular injection. The orally administered arsenic appeared in the tissues in an altered form that is presumed organic; this organoarsenical was also found in the gastrointestinal contents. The injected arsenic appeared in the tissues in inorganic form and was only slowly converted to organic form; meanwhile, large amounts of inorganic and organic arsenic were detected in the bile. These findings are consistent with biosynthesis of the organic arsenic compound within the gastrointestinal tract.

75-000610 Rajan, K. C.; Nair, N. B. (Dep. Aquatic Biol. Fish., Univ. Kerala, Trivandrum, India) EFFLUENT RESISTANCE OF SOME SPECIES OF INTERSTITIAL ANIMALS TO INDUSTRIAL WASTES. Bol. Inst. Oceanogr. Univ. Oriente Cumana 13 (1-2): 125-128. Dec. 1974. In English with Spanish summ. SFA 20(4).

The reaction of 2 species each of copepods and nematodes, one species each of archiannelid and polychaete collected from the sandy beach to varying concentrations of effluents from a titanium factory has been examined. It was found that concentrations higher than 0.0021 g/l iron with pH 7.1 are lethal for all animals tested. the lowest resistance was shown by the copepod *Paramesochra wilsoni* and the polychaete *Pisione complexa*, the nematodes showed higher resistance while the archiannelid *Polygordius madrasensis* showed a much higher resistance to these effluents.

75-000611 Roberts, M. H., Jr.; Diaz, R. J.; Bender, M. E.; Huggett, R. J. (Va. Inst. Mar. Sci., Gloucester Point 23062) ACUTE TOXICITY OF CHLORINE TO SELECTED ESTUARINE SPECIES. J. Fish. Res. Board Can. 32 (12): 2525-2528. Dec. 1975. In English with French summ. SFA 20(4).

Two flowing water systems designed to test the acute toxicity of chlorine in estuarine water are described, one adapted for microscopic species, the other for larger species. Acute toxicity results for several invertebrate and fish species are presented. Molluscan larvae and *Acartia tonsa* were the most sensitive species tested, with 48-h TL50 values less than 0.005 ppm.

75-000612 Ruesink, R. G.; Smith, L. L., Jr. (Dep. Entomol. Fish. Wildl., Univ. Minn., St. Paul 55101) THE RELATIONSHIP OF THE 96-HOUR LC(50) TO THE LETHAL THRESHOLD CONCENTRATION OF HEXAVALENT CHROMIUM, PHENOL, AND SODIUM PENTACHLOROPHENATE FOR FATHEAD MINNOWS (*PIMEPHALES PROMELAS*/ *RAFINESQUE*). Trans. Am. Fish. Soc. 104 (3): 567-570. July 1975. SFA 20(4).

Short-term bioassays were conducted with adult fathead minnows and hexavalent chromium, phenol, and sodium pentachlorophenate at 2 temperatures to determine the relationship of the 96-hour LC(50) to the lethal threshold concentration.

The lethal threshold concentration was less than the 96-hour LC(50) in 10 of 12 bioassays, was affected by temperature, and was not a constant multiple of the 96-hour LC(50) for any of the toxicants tested.

75-000613 Silvo, O. E. J. (Suunnittelukeskus Oy, Pananotkonkatu 2, 00130 Hesinski 13, Finland) ALUSTAVIA TUTKIMUKSIA DIOKTYLPHTALAATIN (DOP) AKUUTISTA MYRKYLLISYYDESTÄ KIRJOLOHELLE (*/SALMO GAIRDNERI*/ RICHARDSON) JA SEN VAIDUTUKSISTA KASVIPLANKTONIIN SEDA VEDEN HAPITALOUTEEN. [PRELIMINARY STUDIES ON THE ACUTE TOXICITY OF DIOCTYLPHTHALATE (DOP) TO RAINBOW TROUT (*/SALMO GAIRDNERI*/ RICHARDSON) AND ITS EFFECTS UPON THE PHYTOPLANKTON AND OXYGEN CONTENT OF THE WATER.] Snom. Kalatalous No. 47. 19-25. 1974. In Finnish with English and Swedish summ. SFA 20(4).

Diocetylphthalate (DOP or DEHP) is used in industry in large quantities as a plasticiser in the production of PVC and some other plastics. The acute toxicity of DOP to young rainbow trout (*/Salmo gairdneri*/ Richardson), aged about one year, was studied in aquaria. The DOP concentrations used were 1, 10, 100 and 1,000 mg/l. DOP had been dissolved in ethyl alcohol at a rate of 1 : 1. The test fish survived for at least 48 hours at every concentration tested. The effect of DOP upon the phytoplankton and the oxygen content of the water was studied in an artificial pond. DOP was used at a rate of 1500 mg/litre, being added to the water without any solvent. DOP settled on the surface of the water like layer of oil. In spite of this, the oxygen concentration stayed above 100 percent of saturation throughout the 9-day test. */Chlamydomonas* sp. was dominant in the phytoplankton during the whole test. Its biomass increased more than ninefold in 8 days. The biomass of */Scenedesmus acutus*/ increased about thirtyfold in the same period.

75-000614 Smith, C. E.; Russo, R. C. (U.S. FWS, Fish Cult. Dev. Cent., Bozeman, MT 59715) NITRITE-INDUCED METHEMOGLOBINEMIA IN RAINBOW TROUT. Prog. Fish-Cult. 37 (3): 150-152. July 1975. SFA 20(4).

Rainbow trout (*Salmo gairdneri*) averaging 30 g each were exposed continuously to inflowing water containing from 0.096 to 0.78 mg/liter nitrite as nitrite nitrogen. Exposure to 0.096 mg/liter for 8 days resulted in a small but significant (P less than 0.01) elevation of methemoglobin. Exposure to higher concentrations also resulted in significant increases in methemoglobin.

75-000615 Syrett, R. F.; Dawson, W. F. (U.S. EPA, Natl. Water Qual. Lab., Duluth, MN 55804) AN INEXPENSIVE SOLID-STATE TEMPERATURE CONTROLLER. Prog. Fish-Cult. 37 (3): 171-172. July 1975. SFA 20(4).

The construction of a solid-state temperature-control unit costing about \$50 is described. This unit energizes either resistive or inductive loads with temperature changes as small as 0.01 degrees C. The sensor is a thermistor which serves as one arm of a Wheatstone bridge.

75-000616 Thomas, R. E.; Rice, S. D. (Dep. Biol. Sci., Chico State Univ., Chico, CA 95926) INCREASED OPERCULAR RATES OF PINK SALMON (*ONCORHYNCHUS GORBUSCHA*) FRY AFTER EXPOSURE TO THE WATER-SOLUBLE FRACTION OF PRUDHOE BAY CRUDE OIL. J. Fish. Res. Board Can. 32 (11): 2221-2224. Nov. 1975. In English with French summ. SFA 20(4).

The opercular rates of pink salmon (*Oncorhynchus gorbuscha*) fry were measured during 24-h exposure to sublethal concentrations of the water-soluble fraction of Prudhoe Bay crude oil. Opercular rates increased significantly for as long as 9 and 12 h after exposure to water-soluble fractions prepared from oil-water solutions of 2.83 and 3.46 ppm. The increases in rates were proportional to increases in dose. Recording changes in opercular rates appears to be a suitable method for detecting sublethal physiological effects of stress, because the observed changes occurred at approximately 20 percent of the 96 h-LC50.

75-000617 Townsend, B. E.; van der Veen, B.; Flannagan, J. F. (Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB, Canada) ELECTRONIC SYSTEMS FOR THE CONTINUAL MONITORING OF TEMPERATURE, PH, CONDUCTIVITY AND DISSOLVED OXYGEN. Environ. Can. Fish. Mar. Serv. Tech. Rep. No. 517. ii + 15p. 1975. In English with French summ. SFA 20(4).

This paper describes four electronic systems which enabled temperature, pH, conductivity and dissolved oxygen to be continuously monitored in a series of experimental tanks. The system proved economical in both time and manpower and as many as 24 individual tanks could be monitored every 12 minutes. It also proved reliable in long term toxicity studies for aquatic invertebrates and compatible with dilution toxicant dispensing apparatus.

75-000618 Veith, G. D.; Comstock, V. M. (U.S. EPA, Natl. Water Qual. Lab., Duluth, MN 55804) APPARATUS FOR CONTINUOUSLY SATURATING WATER WITH HYDROPHOBIC ORGANIC CHEMICALS. J. Fish. Res. Board Can. 32 (10): 1849-1851. Oct. 1975. In English with French summ. SFA 20(4).

An apparatus for generating and maintaining water solutions saturated with hydrophobic organic chemicals is described. The saturator replaces the reagent stock bottle and the organic solvents used in conventional diluters, and has ample capacity to dose large volumes of water necessary for long-term toxicology studies with aquatic organisms. The water in a constant-level reservoir is

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continuously saturated with the chemical by circulating the water through a bed of an inert substrate impregnated with the chemical under investigation.

75-000619 Waltemyer, D. L. (Ichthyol. Assoc., Inc., P.O. Box 223, Etters, PA 17319) THE EFFECT OF TANNIN ON THE MOTILITY OF WALLEYE (/STIZOSTEDION VITREUM/) SPERMATOOZA. Trans. Am. Fish. Soc. 104 (4): 808-810. Oct. 1975. SFA 20(4).

In recent years, tannin has been used to decrease adhesiveness of walleye eggs during artificial propagation. Spermatozoa samples were taken from ripe male walleye to investigate the effect of tannin concentrations on spermatozoa motility or fertilizing capacity. A statistically significant relationship in reduction of spermatozoa motility with increasing tannin concentrations resulted. Consequently, tannin does influence the fertilizing capacity of walleye spermatozoa and hence during artificial propagation should not be added until the second rinse after fertilization.

75-000620 Wobeser, G. (Dep. Vet. Pathol., Univ. Saskatchewan, Saskatoon, SK S7N 0W0, Canada) ACUTE TOXICITY OF METHYL MERCURY CHLORIDE AND MERCURIC CHLORIDE FOR RAINBOW TROUT (/SALMO GAIIRDNERI/) FRY AND FINGERLINGS. J. Fish. Res. Board Can. 32 (11): 2005-2013. Nov. 1975. In English with French summ. SFA 20(4).

The median tolerance limit (MTL) for methyl mercury chloride at 24, 48, and 96 h was 0.084, 0.045, and 0.024 mg/liter as mercury, respectively, for fry; and 0.125, 0.066, and 0.042 mg/liter as mercury, respectively, for fingerlings. The MTL (24 h) for mercuric chloride for fingerlings was 0.90 mg/liter as mercury. Fingerlings exposed to methyl mercury chloride concentrated mercury in their tissues much more rapidly than did those exposed to mercuric chloride. The acute toxic action of both compounds was exerted on the gills. Mercuric chloride caused severe epithelial necrosis. Poisoning by methyl mercuric chloride was characterized by epithelial cell swelling and hyperplasia, a marked increase in the number of epithelial cells in mitosis, and terminal epithelial desquamation.

75-000621 Wobeser, G. (Dep. Vet. Pathol., Univ. Saskatchewan, Saskatoon, SK S7N 0W0, Canada) PROLONGED ORAL ADMINISTRATION OF METHYL MERCURY CHLORIDE TO RAINBOW TROUT (/SALMO GAIIRDNERI/) FINGERLINGS. J. Fish. Res. Board Can. 32 (11): 2015-2023. Nov. 1975. In English with French summ. SFA 20(4).

Rainbow trout (/Salmo gairdneri/) fingerlings were fed rations containing 4, 8, 16, and 24 ppm mercury as methyl mercury chloride over a 105-day period. Fish receiving the 16- and 24-ppm rations had significantly higher blood packed cell volumes than did controls. Hyperplasia of the gill epithelium was the only morphologic alteration detected in these fish. Individual fish accumulated up to 30 ppm mercury in muscle tissue, but no mortality that could be attributed to mercury occurred.

The results suggest that trout can tolerate a large body burden of mercury, if this mercury is acquired over a period of time.

75-000622 Zanini, E.; Ghittino, P.; Sapetti, C.; Barberis, E. (Ist. Chim. Agrar., Via P. Giuria, 15-10126 Torino, Italy) ACCUMULO E POSSIBILI BIOCONVERSIONI DI COMPOSTI ORGANICI E INORGANICI DEL MERCURIO IN TROTE IRIDEE NUTRITE CON DIETE INQUINATE SPERIMENTALMENTE. [STORAGE AND POSSIBLE BIOCONVERSIONS OF ORGANIC AND INORGANIC MERCURY COMPOUNDS IN RAINBOW TROUT FED EXPERIMENTALLY CONTAMINATED DIETS.] Riv. It. Piscic. Ittiop. 10 (2): 53-57. Apr.-May-June 1975. In Italian with English summ. SFA 20(4).

The authors studied the evolution of organic and inorganic mercury compounds in the body of rainbow trout fed two months with diets experimentally contaminated.

Yearling rainbows (35 g) and table-rainbows (300 g) were kept in aquaria supplied with dechlorinated tap water (15°C). They received 2-5 percent body weight a day ground beef liver, containing binders (2 percent NaCl, 4 percent CMC), added of inorganic mercury (10.3 mg/Kg of Hg as HgCl₂) and organic mercury 10.3 mg/Kg of Hg as CH₃HgCl. Three samplings were made, every 20 day. From killed trout, when possible, liver, brain, kidney, muscle, blood, and gonads, were sampled. On these samples total mercury was analyzed by using Atomic Absorbment Spectrophotometry (AAS) without flame; methylmercury was checked by gaschromatography.

During two months of research, mercury appeared as quickly accumulated by trout. In trout /liver/ (in ug/g) total mercury increased from 0.001 (start, control) until 17.92-19.78, and methylmercury until 19.57; in trout /brain/, total mercury from 0.001 until 27.17-9.80; in trout /blood/, total mercury from 0.023 until 15.48, and methylmercury from 0.001 until 4.10; in trout /muscle/, total mercury from 0.005 until 9.62; in trout /gonads/, total mercury from 0.015 until 6.22; in trout /kidney/, total mercury from 0.021 until 12.93, and methylmercury from 0.001 until 12.55. Trout eliminated remarkable amount of mercury in feces (3.65-12.56).

In the discussion of the results, the authors haven't observed a demethylation of methylmercury by trout; they speculated a partial methylation of inorganic mercury, likely in trout intestine.

FISH TOXICANTS

75-000623 Courtois, L. A. (Water Pollut. Contr. Lab., Rancho Cordova, CA 95670) HEMATOLOGICAL ASSESSMENT AND TOXICITY OF ANTIMYCIN A TO GOLDEN SHINERS, /NOTEMIGONUS CRYSOLEUCAS/. Prog. Fish-Cult. 37 (4): 202-204. Oct. 1975. SFA 20(4).

Hematological parameters were established for /Notemigonus crysoleucas/ collected from the wild and acclimated to 10±0.5°C for 25 days. Results displayed little variation among groups. Antimycin A (Fintrol) was evaluated against this same group of acclimated fish to determine minimum concentration for effective control. Antimycin A was 100 percent effective at a concentration of 1.0 ug/l.

75-000624 Dawson, V. K. (U.S. FWS, Fish. Contr. Lab., La Crosse, WI 54601) COUNTERACTING CHEMICALS USED IN FISHERY OPERATIONS: CURRENT TECHNOLOGY AND RESEARCH. In P. H. Eschmeyer, ed. Rehabilitation of Fish Populations with Toxicants: A Symposium. North Cent. Div., Am. Fish. Soc., Spec. Publ. No. 4. 32-40. May 1975. SFA 20(4).

Counteraction of chemicals used in fishery management is a desirable and often necessary aspect of rehabilitation operations. Frequently a chemical must be prevented from escaping the treated area after it has performed the intended function. Although few techniques for counteracting fishery chemicals have been perfected, several are either currently in use or are being developed. These include the use

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of microorganisms, coagulants, ultraviolet light, chemical deactivators, and adsorbents. Almost all the the methods currently available have certain limitations, depending on the conditions under which they are used. Therefore, in some situations, integrated systems involving more than one technique may be desirable for effective counteraction.

75-000625 Hunn, J. B.; Allen, J. L. (U.S. FWS, Fish Contr. Lab., La Crosse, WI 54601) RENAL EXCRETION IN COHO SALMON (/ONCORHYNCHUS KISUTCH/) AFTER ACUTE EXPOSURE TO 3-TRIFLUOROMETHYL-4-NITROPHENOL. J. Fish. Res. Board Can. 32 (10): 1873-1876. Oct. 1975. In English with French summ. SFA 20(4).

Coho salmon (/Oncorhynchus kisutch/) exposed to an acute, sublethal concentration of 3-trifluoromethyl-4-nitrophenol (TFM) exhibited an increased output of urine when compared with controls, but the urinary excretion of Na, K, Ca, Mg, and Cl was not affected. About 35 times more conjugated TFM than free TFM was excreted during the 24-h study period.

75-000626 Marking, L. L. (U.S. FWS, Fish. Contr. Lab., La Crosse, WI 54601) TOXOCOLOGICAL PROTOCOL FOR THE DEVELOPMENT OF PISCICIDES. In P. H. Eschmeyer, ed. Rehabilitation of Fish Populations with Toxicants: A Symposium. North Cent. Div., Am. Fish. Soc., Spec. Publ. No. 4. 26-31. May 1975. SFA 20(4).

Potential fish toxicants must be investigated intensively in the laboratory before they are used in fish culture or in the reclamation of waters to improve sport fishing. Laboratory studies are designed to provide data needed to meet safety and efficacy requirements for registration. A protocol is presented here to serve as a guide for evaluating the toxicity of a chemical to aquatic organisms. Acute and chronic toxicities are determined in static and flow-through tests in which the susceptibility of target and nontarget organisms to the lethal action of the chemical is assessed. Properly designed tests generate data on classical and use-pattern toxicity. Classical toxicity information includes LC50 values that are determined under standard conditions and make possible the comparison of toxicity of a candidate compound with that of other substances or the comparison of toxicity to a different species. The duration of a classical toxicity test usually is 24 to 96 hours. Use-pattern toxicity relates to the determination of the effects of concentrations proposed for field use; LC99's or observed 100 percent effects are more meaningful than LC50's for these determinations. The duration of use-pattern tests is governed by the exposure time required to kill target fishes and generally varies with different toxicants.

75-000627 Radonski, G. C. (Ayerst Lab., Springfield, MO 65804) PROBLEMS IN MARKETING A FISH TOXICANT. In P. H. Eschmeyer, ed. Rehabilitation of Fish Populations with Toxicants: A Symposium. North Cent. Div., Am. Fish. Soc., Spec. Publ. No. 4. 22-25. May 1975. SFA 20(4).

Problems facing the manufacturers of fish toxicants are discussed, with special emphasis on problems over which the manufacturers have least control, such as federal registration of the product and the philosophical question of moral responsibility. Formulation and techniques for use of fish toxicants have been greatly improved and refined in recent years. Fishery biologists now can choose among a variety of fish toxicants, depending on the physical and biological conditions in the body of water to be treated. This choice, too, has added to the problems of the manufacturer because the increasing potency and sophistication on control chemicals requires that the

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biologists using them be increasingly competent. Registration of a compound is usually the responsibility of the manufacturer. In fisheries, however, the active participation of the federal government in the registration procedure is necessitated by the high cost of attaining and maintaining registration, in the face of low market demand. Moral responsibility falls on both the manufacturer and the fishery scientist. The manufacturer should provide the best product possible. The fishery scientist should give the highest consideration to the environment and the biotic community that are being manipulated.

RESEARCH AND MANAGEMENT-GENERAL

75-000628 Anderson, L. G. (Univ. Del., Newark 19711) ANALYSIS OF OPEN-ACCESS COMMERCIAL EXPLOITATION AND MAXIMUM ECONOMIC YIELD IN BIOLOGICALLY AND TECHNOLOGICALLY INTERDEPENDENT FISHERIES. J. Fish. Res. Board Can. 32 (10): 1825-1842. Oct. 1975. In English with French summ. SFA 20(4).

Fisheries may be interdependent because of biological relationships that exist between their stocks or because the gear of one affects mortality in the stock of the other. The problems of defining a maximum sustainable yield in these cases are discussed. A graphical analysis is used to describe the combinations of effort from both fisheries where concurrent exploitation is possible and which of these combinations will result in a simultaneous equilibrium. Finally the conditions for a combined maximum economic yield (MEY) are presented and it is shown that they will not hold if each fishery is managed to obtain an individual MEY.

75-000629 Pollution Committee, South. Div. Am. Fish. Soc. MONETARY VALUES OF FISH. iv + 18p. 1975. Available from: W. H. Peltier, Ecology Branch-Region IV, U.S. EPA, College Stn. Rd., Athens, Ga. 3060. SFA 20(4).

Every fish has a value. The compensation for the loss of fish due to water pollution mandates a readily assessible table of values for fishes of all species. For this purpose, the Pollution Committee, Southern Division, American Fisheries Society has prepared the following list of fishes and their individual values.

The original values published in 1970 represented the results of a comprehensive survey involving a majority of all commercial fish hatcheries in the Southeastern United States, compiled and prepared by recognized experts in the field of fishery biology. The sources in the appendix provided the price-data for those original values. (From Auth. Intro.)

75-000630 Silliman, R. P. (4135 Baker NW, Seattle, WA 98107) EXPERIMENTAL EXPLOITATION OF COMPETING FISH POPULATIONS. NOAA Fish. Bull. 73 (4): 872-888. Oct. 1975. SFA 20(4).

Populations of the guppy, *Poecilia reticulata*, and the swordtail, *Xiphophorus maculatus*, x *X. helleri*, were grown both independently and in competition under controlled conditions. Independent populations were permitted to grow for about a year and then successively exploited at two different rates for each species. In the control (unfished) pair of competing populations, both species grew for about 30 weeks, followed by decline and extinction of the swordtail and fluctuations in the guppy. Similar initial growth in the test pair was followed by exploitation of both species at various combinations of rates.

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Measures of recruitment were available as weights of juveniles returned to adult tanks from separate nursery tanks. Data from fitted curves showed that guppy recruitment exceeded that of the swordtail under both independent and competing conditions. Depression of recruitment by competition was greater in the swordtail than in the guppy.

A mathematical model for competing populations consisted of a pair of differential equations including the elements of the Volterra competition formulae and the Fox exponential surplus-yield model. By using the exploitation rates applied in the experiments, and constants from the independent populations, the model was applied to biomass data from the control pair of competing populations. Successive trials resulted in a reasonably good fit, and competition coefficients from this were used to fit data from the exploited test pair. Yield isopleths calculated from the fitted model showed that maximal yields were obtained when exploitation for the swordtail was lower than for the guppy, suggesting lower productivity in the swordtail. The maximum sustainable yield represented about 20 percent of food placed in tanks, and indicated at least as great efficiency from competing populations as from independent ones.

Results from the experiments clearly suggest that exploiting both members of a competing pair is preferable to exploiting either alone, provided fishing rates are adjusted in relation to the productivity of each species.

75-000631 Tomlinson, J. W. C.; Vertinsky, I. (Div. Int. Bus. Stud., Univ. B.C., Vancouver V6T 1W5, Canada) INTERNATIONAL JOINT VENTURES IN FISHING AND 200-MILE ECONOMIC ZONES. J. Fish. Res. Board Can. 32 (12): 2569-2579. Dec. 1975. In English with French summ. SFA 20(4).

This paper examines the impact of various strategies that may be adopted by coastal nations for utilization of fishery resources assigned to their jurisdiction under a system of 200-mile economic zones, such as that apparently favored at the Caracas Conference on the Law of the Sea. Benefits and problems that are likely to arise out of alternative approaches are discussed in the context of experiences of developing countries with foreign investment in other sectors. The paper suggests that various forms of joint ventures appear to have the greatest chance of success in achieving both effective utilization of resources and beneficial development of the coastal nations.

75-000632 U.S. Fish Wildl. Serv. (Washington, DC 20240) FEDERAL AID IN FISH AND WILDLIFE RESTORATION 1974. Wildl. Manage. Inst. & Sport Fish. Inst., Washington, D.C. iv + 138p. 1975. SFA 20(4).

Annual report on Dingell-Johnson and Pittman-Robertson programs for the fiscal year ending June 30, 1974.

ADMINISTRATION AND PLANNING

75-000633 Peterman, R. M. (Inst. Anim. Resour. Ecol., Univ. British Columbia, Vancouver, BC V6T 1W5, Canada) NEW TECHNIQUES FOR POLICY EVALUATION IN ECOLOGICAL SYSTEMS: METHODOLOGY FOR A CASE STUDY OF PACIFIC SALMON FISHERIES. J. Fish. Res. Board Can. 32 (11): 2179-2188. Nov. 1975. In English with French summ. SFA 20(4).

The complexity of exploited ecological systems creates difficulties for the manager who must decide among alternative policy options. Some methods for overcoming these difficulties are presented, using examples from the salmon fishery of the Skeena River system in British Columbia. The described methods produced a "desk-top optimizer," a

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tool that permits decision-makers to perform fairly sophisticated "optimization" operations at their desks instead of having to rely on decision theorists or operation researchers. Also discussed are various system indices which should become part of the information used by managers. These indices include measures of resilience (ability to absorb the effects of unexpected events), costs of failures in management policies, and costs of uncertainty of various types.

75-000634 Powers, J. E.; Lackey, R. T.; Zuboy, J. R. (Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA 24061) DECISION-MAKING IN RECREATIONAL FISHERIES MANAGEMENT: AN ANALYSIS. Trans. Am. Fish. Soc. 104 (3): 630-634. July 1975. SFA 20(4).

A conceptual model of the decision-making process in fisheries management is presented in conjunction with applications of computer and systems analysis to this process. One of the most difficult problems to solve is selecting objectives to be used for management evaluation. An objective function based on some or all of the components of yield, species, size desirability, and environmental quality is needed. Systems analysis and computer technology in data processing and simulation may be used in many situations to evaluate decision alternatives as an aid in developing management strategies.

REPORTS OF FISHERY STATIONS, STATES, ETC.

75-000635 Brun, B. (Fish. Manage. Div., Minist. Agric. Fish., Wellington, New Zealand) FISHERIES MANAGEMENT DIVISION INVESTIGATIONS PROGRESS REPORT 1974. N. Z. Minist. Agric. Fish., Fish. Tech. Rep. No. 140. 29p. 1975. SFA 20(4).

This report describes the work completed or in progress during the 1974 calendar year in the Fisheries Management Division of the Ministry of Agriculture and Fisheries. (From Auth. Intro.)

HABITAT ALTERATION

75-000636 Dryden, R. L.; Stein, J. N. (Fish. Mar. Serv., Winnipeg, MB, Canada) GUIDELINES FOR THE PROTECTION OF THE FISH RESOURCES OF THE NORTHWEST TERRITORIES DURING HIGHWAY CONSTRUCTION AND OPERATION. Environ. Can., Fish. Mar. Serv., Tech. Rep. Ser. No. CEN/T-75-1. vi + 32p. 1975. SFA 20(4).

Based on the results of fisheries investigations conducted between 1971 and 1974, guidelines have been designed to protect the fish resources of the Districts of Keewatin and Mackenzie, as well as Baffin and Southampton Islands, from major disruptions resulting from the construction and operation of highway and road systems. These guidelines are not intended to serve as regulations but merely as an aid in meeting Fisheries and Marine Service requirements, as defined by the Fisheries Act of Canada.

Culvert average cross-sectional velocities must not exceed 0.9 m/s (3 fps) when fish passage is a requirement, unless it can be satisfactorily demonstrated that the culvert design includes a selected region wherein velocities are low enough to permit fish passage. This selected region must be continuous throughout the culvert length and of sufficient size to permit the fish to locate it and to swim through it. Alternatives such as baffles should be considered when these velocity criteria can not be met through regular

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design procedures. The minimum desirable water level within culverts during periods of fish movement should be 20.3 cm (8 inches).

In general, no instream construction activity should be attempted from May 1 to June 30 and from September 1 to November 15, as these periods are considered critical to fish migrations and spawning. However, these dates vary slightly with geographical spread and variations in the timing of freeze-up and break-up. The spring or fall restrictions may be lifted if it can be satisfactorily demonstrated that fish spawning activities do not occur during either or both of these periods in the stream under consideration.

Three days is considered the maximum time period during which the blockage to annual spawning migrations can be tolerated without causing serious disruption to the spawning cycle. During this three day period, the above mentioned velocity criteria need not be adhered to. Variables such as the timing of fish migration and the timing and duration of peak flows will determine when this three day delay limitation should be in effect.

The removal of stream gravel may seriously damage spawning habitat and therefore should not be attempted without first determining the spawning potential of the area in question and consultation with Fisheries and Marine Service. Highway routing should avoid close proximity or paralleling of streams or water bodies, and should cross river systems as far upstream from the river mouth or as far downstream from a lake outlet as possible.

Specific restrictions, other than those discussed within these guidelines, may have to be imposed where unique fish species or life history aspects are involved. Conversely, the guidelines may be tempered upon consideration of species composition or the individual characteristics of a stream system. Fisheries and Marine Service is available to provide advice and guidance with respect to the fisheries resource for any highway design or construction proposal in the Northwest Territories.

75-000637 Huckabee, J. W.; Goodyear, C. P.; Jones, R. D. (Environ. Sci. Div., Oak Ridge Natl. Lab., Oak Ridge, TN 37830) ACID ROCK IN THE GREAT SMOKIES: UNANTICIPATED IMPACT ON AQUATIC BIOTA OF ROAD CONSTRUCTION IN REGIONS OF SULFIDE MINERALIZATION. Trans. Am. Fish. Soc. 104 (4): 677-684. Oct. 1975. SFA 20(4).

After the completion of a highway construction project in Great Smoky Mountains National Park in 1963, a fish kill was noted in a small stream draining an area of roadbed fill. After 10 years, the stream remained devoid of fish for at least 8 km downstream from the fill. The downstream water had a pH of 4.5 to 5.9; upstream from the fill the pH was 6.5 to 7.0. The rock material in the fill contains iron sulfide minerals. Other streams in the area flowing on the sulfide-rich rocks also showed low pH values. Survivability tests and stream surveys showed that brook trout cannot tolerate conditions in the stream below the road fill or in a stream flowing over natural outcrops of the same rock used in construction of the road fill. Native salamanders were also adversely affected downstream from the road fill. Chemical analyses of stream water and leaching tests indicated that lowered pH and increased sulfate and metals concentrations derived from the leaching of the sulfide-rich rocks were responsible for the trout and salamander mortalities.

HARVEST, CREEL CENSUS

75-000638 Higham, J. R. (U.S. FWS, Galveston, TX 77550) THE COMMERCIAL FISHERY IN LAKE OAHE, NORTH AND SOUTH DAKOTA, 1964-70. U.S. Fish Wildl. Serv. Tech. Pap. 80. 15p. 1974. SFA 20(4).

Ten species were commercially harvested in Lake Oahe, among which bigmouth buffalo (*Ictiobus cyprinellus*) predominated (63.8 percent of the total weight), smallmouth buffalo (*Ictiobus bubalus*) and goldeye (*Hiodon alosoides*) ranked second, and third. Variations in the seasonal and annual production of buffalo were governed by market conditions and availability. Production of minor species depended on the amount of fishing effort directed toward the harvest of buffalo. Gill and hoop nets were the principal fishing gears. The fishing season usually extended from April through December; most fishing was in May through August.

75-000639 Sinclair, W. F.; Morley, R. W. (Fish. Mar. Serv., Vancouver, BC V6E 2P1, Canada) STATISTICAL BIAS PROBLEM IN ON-SITE SURVEYS: THE SEVERITY OF THE PROBLEM AND ITS POTENTIAL FOR SOLUTION. J. Fish. Res. Board Can. 32 (12): 2520-2524. Dec. 1975. In English with French summ. SFA 20(4).

Commercial and recreational fisheries managers often develop catch and effort estimates from information gathered in location or on-site surveys. However, a limited on-site sample cannot produce unbiased estimates of fishing effort or socioeconomic traits of the anglers unless weighting procedures are adopted to account for the varying frequencies of fishing of the fishermen. The corrective procedure involves establishing the relative probability of capturing a fisherman in the sample, then weighting the number of contacts with anglers in each frequency of use category. Unless information on the probability of including particular fishermen and fishing vessels in the sample is available the sample must be drawn with replacement.

REGULATIONS

75-000640 Hill, T. K.; Shell, E. W. (Entomol.-Fish. Dep., Coastal Plain Exp. Stn., Tifton, GA 31794) SOME EFFECTS OF A SANCTUARY ON AN EXPLOITED FISH POPULATION. Trans. Am. Fish. Soc. 104 (3): 441-445. July 1975. SFA 20(4).

A 10.3-hectare impoundment at Auburn, Alabama, was stocked with bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), and fathead minnow (*Pimephales promelas*) at densities of 1,852, 617, 247, 247, and 2,470 per hectare, respectively, during December, 1965 to June, 1966. When the impoundment was opened to public fishing in May 1967, half the shoreline and 90 percent of the impounded area were closed to fishermen. Compared with typical non-sanctuary ponds under similar fishing pressures, the initial catch rates of bass and sunfish were lower in the sanctuary pond. The presence of the sanctuary did not reduce the total catch per hectare, but the catch was spread over a longer fishing season.

FISH CONTROL AND REMOVAL

75-000641 Becker, G. (Univ. Wis., Stevens Point 54481) FISH TOXIFICATION: BIOLOGICAL SANITY OR INSANITY? In P. H. Eschmeyer, ed. Rehabilitation of Fish Populations with Toxicants: A Symposium. North Cent. Div., Am. Fish. Soc., Spec. Publ. No. 4. 41-53. May 1975. SFA 20(4).

In opposition to massive fish poisoning projects in Wisconsin, environmental organizations and the academic community have sought relief through the courts. Strongest opposition has been directed against the Wisconsin Department of Natural Resources in its antimycin-rotenone program for the Rock River watershed, which includes 5 percent of the total area of the state. Pre- and post-treatment surveys of several waters have shown a sharp decrease in the number of species of fish. An analysis of antimycin field tests held in 1965 and 1967 showed, even as late as 1972, a decrease in the number of fish species and an apparent reduction in the number of individuals for many species. Attention is called to the fact that ecological changes have not been investigated, nor is it clear why certain fish populations have remained depressed. Concern is voiced for the unique gene pools in forage fishes and for the rare and endangered fishes which are eliminated through mass poisoning projects. In Wisconsin no attempts have been made to protect known rare and endangered fishes. Also, the effects of antimycin on aquatic insects, clams, and other organisms are just beginning to become evident. Initial data show that clams are particularly sensitive, and that some species may have been eradicated. Mass poisoning of waters appears to work contrary to those biological and ecological principles which support the concept that great species diversity leads to stability of the environment. I am concerned that a reduction in species diversity will lead to instability, accompanied by new, often unforeseen, problems. Careful use of fish toxicants and renewed emphasis on standard fish management procedures are recommended. A policy statement on the use of fish toxicants for fish management is included.

75-000642 Cumming, K. B. (U.S. FWS, Fish Contr. Lab., La Crosse, WI 54601) HISTORY OF FISH TOXICANTS IN THE UNITED STATES. In P. H. Eschmeyer, ed. Rehabilitation of Fish Populations with Toxicants: A Symposium. North Cent. Div., Am. Fish. Soc., Spec. Publ. No. 4. 5-21. May 1975. SFA 20(4).

Many bodies of water have been overrun with fish species that are undesirable for the well-being of endemic aquatic biota and are of little or no interest to anglers. This situation has resulted from the transplanting of fish, creation of new waters, increasing fishing pressure, and changing water quality. Although as many as 30 toxicants have been tried, only about 10 major piscicides have been used in rehabilitation programs to remove the unwanted species. Explicit knowledge of the mode of action of toxicants in the environment and improvements in fish farming have permitted fishery managers to reduce the amount of control chemical that is applied to obtain a desired result. The number and volume of waters being reclaimed have increased, but this trend may change soon because environmental laws involving the use of registered pesticides are becoming more restrictive. Registration research has established the safety of some fish toxicants but has eliminated others. Only four piscicides are presently registered for nonfood use application: antimycin and rotenone as general fish toxicants and 3-trifluoromethyl-4-nitrophenol (TFM) and Bayluscide as selective lampricides.

75-000643 Eschmeyer, P. H., ed. (U.S. FWS, Aylesworth Hall-CSU, Ft. Collins, CO 80523) REHABILITATION OF FISH POPULATIONS WITH TOXICANTS: A SYMPOSIUM. North Cent. Div., Am. Fish. Soc., Spec. Publ. No. 4. v + 74p. May 1975. SFA 20(4).

A collection of ten papers designed to point out the importance of toxicants in fishery management, to present information on their use and development, and to indicate problems associated with their use. (RS)

75-000644 Hudson, G. E. (Ind. Dep. Nat. Resour., Indianapolis 46204) RENOVATION OF CAGLES MILL (INDIANA) RESERVOIR AND ITS TRIBUTARIES. In P. H. Eschmeyer, ed. Rehabilitation of Fish Populations with Toxicants: A Symposium. North Cent. Div., Am. Fish. Soc., Spec. Publ. No. 4. 66-70. May 1975. SFA 20(4).

Cagles Mill Reservoir (Cataract Lake) is a 1,400-acre reservoir constructed on Mill Creek by the U.S. Army Corps of Engineers in 1953 to provide flood control for the Eel and White River basins in West-central Indiana. After routine surveys in 1963-71 revealed a steadily declining sport fishery in the reservoir and its tributaries, the Department of Natural Resources recommended that the reservoir be drained and the fish be eradicated in the 403 miles of stream within the watershed. The project was approved by the Corps of Engineers and was carried out in October 1971. Forty biologists assisted in the project, as well as personnel from the Divisions of Enforcement and State Parks. The tributaries were treated with rotenone during the period October 13-16, and reservoir draining was begun on 15 October. Before draining was complete, 3,000 pounds of largemouth bass, 800 pounds of channel catfish, and 3,200 pounds of flathead catfish were salvaged with electrofishing gear. Draining was completed by 23 October; treatment of the lake basin resulted in the removal of an estimated 600,000 pounds of fish. Total cost of the project was \$21,000. Nine species were restocked in the reservoir or the watershed in 1971-72. Game fish dominated the population, and fishing quality improved in 1973.

75-000645 Klingbiel, J. H. (Wis. Dep. Nat. Resour., Madison 53701) USE OF FISH TOXICANTS IN WISCONSIN, 1941-73. In P. H. Eschmeyer, Ed. Rehabilitation of Fish Populations with Toxicants: A Symposium. North Cent. Div., Am. Fish. Soc., Spec. Publ. No. 4. 54-59. May 1975. SFA 20(4).

The first use of fish toxicants in Wisconsin was in 1941, when a number of small warm-water lakes were treated. The toxicant program gradually changed to the treatment of small lakes for trout management, and later included larger warm-water lakes, trout streams, and finally large watersheds. To date more than 300 lakes 30,000 acres) and 1,600 miles of streams have been treated. Toxicants are an extremely valuable fish management tool and have allowed the development of desirable fish populations in waters where no other management measures were practical. The use of toxicants, however, is only the first step in the management program. The ultimate results depend on subsequent management measures. Because of the widespread use of toxicants and their possible detrimental effects on the ecosystem, the treatment of each water is carefully planned and evaluated.

75-000646 Lopinot, A. C. (Ill. Dep. Conserv., Springfield 62706) SUMMARY ON THE USE OF TOXICANTS TO REHABILITATE FISH POPULATIONS IN THE MIDWEST. In P. H. Eschmeyer, ed. Rehabilitation of Fish Populations with Toxicants: A Symposium. North Cent. Div., Am. Fish. Soc., Spec. Publ. No. 4. 1-4. May 1975. SFA 20(4).

A survey on the use of fish toxicants in the Midwest showed that more than 22,000 gallons of 2-1/2 percent rotenone were used in 1972 to rehabilitate fish populations. During 1963-72 more than 121,000 acres of water and about 4,200 miles of streams were treated with toxicants. Data are given for each state and province in the Midwest.

75-000647 Robertson, R. (Ind. Dep. Nat. Resour., Knox EFFECT OF RENOVATION ON FISH HARVEST IN J. C. MURPHY LAKE, INDIANA. In P. H. Eschmeyer, ed. Rehabilitation of Fish Populations with Toxicants: A Symposium. North Cent. Div., Am. Fish. Soc., Spec. Publ. No. 4. 71-74. May 1975. SFA 20(4).

A complete creel census has been taken at J. C. Murphy Lake, a 1,500-acre impoundment located entirely within the Willow Slough Fish and Wildlife Area in northwestern Indiana, since it was first fished in 1953. During the first 10 years the catch averaged 1.2 fish per hour and consisted of 67 percent bullheads and 22 percent bluegills. During the 9 years of fishing after renovation, 1965-73, the catch averaged 0.73 fish per hour and consisted of 82 percent bluegills and 11 percent crappies; bullheads dropped to about 2 percent. Although more than 50 percent of all fish taken in 1965-73 were caught through the ice, ice fishermen made up less than 18 percent of the total fishermen.

75-000648 Trimberger, E. J. (Mich. Dep. Nat. Resour., Grand Rapids 49505) EVALUATION OF ANGLER-USE BENEFITS FROM CHEMICAL RECLAMATION OF LAKES AND STREAMS IN MICHIGAN. In P. H. Eschmeyer, ed. Rehabilitation of Fish Populations with Toxicants: A Symposium. North Cent. Div., Am. Fish. Soc., Spec. Publ. No. 4. 60-65. May 1975. SFA 20(4).

Michigan has used chemicals--primarily rotenone--as a means of eliminating or reducing fish populations in lakes and streams since 1934. Most chemical treatments and subsequent population reconstructions have resulted in an increase in the number of desirable game fish available to anglers and an increase in fishing pressure. In chemically reclaimed marginal trout waters, fishing pressure has equalled that in the state's best trout waters. Total chemical reclamations and partial treatments on warm-water lakes consistently provided more angler days per acre than did other management practices.

MARKING AND TAGGING

75-000649 McIlwain, T. D.; Christmas, J. Y. III (NMFS, Gulf Coast Res. Lab., Ocean Springs, MS 39564) A NEW BATCH MARKING TECHNIQUE FOR FINGERLING STRIPED BASS. Prog. Fish-Cult. 37 (3): 123-125. July 1975. SFA 20(4).

A technique for marking fingerling striped bass (*Morone saxatilis*) (80-150 mm total length) using a jet inoculator is described. The instrument injects dyes subdermally. Several dyes were studied. Results show that this technique provides a long-lasting batch mark which is easily and quickly applied, inflicts minimal damage to the fish, and is easily detectable by untrained personnel.

SPORT FISHERY ABSTRACTS

75-000650 Slatick, E.; Wheeler, C. O.; Farr, W. E. (NMFS, Northwest Fish. Cent., Seattle, WA 98112) APPARATUS WITH AUTOMATIC TIMER FOR FREEZE-BRANDING JUVENILE SALMON AND TROUT. Prog. Fish-Cult. 37 (4): 248-249. Oct. 1975. SFA 20(4).

This apparatus was used successfully by relatively inexperienced personnel to cold-brand 36,781 juvenile salmon and trout in 1973 and 467,000 juveniles in 1974; new personnel have branded an average of 4000 fish a day. Recovery of marked juvenile fish at dams on the Snake and Columbia Rivers later in the branding year gave initial indication that good quality cold brands were produced.

The entire unit is portable and can be used at any site where electricity is available, or it can be modified to operate with a 12-volt battery. The cost of this complete apparatus was about \$75.00. (From Auth. Text)

75-000651 Thomas, A. E. (U.S. FWS, Fish Farming Exp. Stn., Stuttgart, AR 72160) MARKING CHANNEL CATFISH WITH SILVER NITRATE. Prog. Fish-Cult. 37 (4): 250-252. Oct. 1975. SFA 20(4).

A technique is described for marking individual catfish with commercial silver nitrate applicators. Distinguishable marks have been retained more than 55 wk.

STOCKING AND INTRODUCTIONS

75-000652 Lear, W. H. (Fish. Mar. Serv., Biol. Stn., St. John's, NF A1C 1A1, Canada) EVALUATION OF THE TRANSPLANT OF PACIFIC PINK SALMON (/ONCORHYNCHUS GORBUSCHA/) FROM BRITISH COLUMBIA TO NEWFOUNDLAND. J. Fish. Res. Board Can. 32 (12): 2343-2356. Dec. 1975. In English with French summ. SFA 20(4).

Five transplants of eyed eggs of Pacific pink salmon (/Oncorhynchus gorbuscha/) were made between streams in southern British Columbia and North Harbour River, Newfoundland. Quantities transplanted were 0.25 million in 1959, 2.5 million in 1962, 3.4 million in 1964, 3.3 million in 1965, and 5.9 million in 1966. Adult returns from these transplants were 1, 49, 638, 8500, and 2426 during 1961, 1964, 1966, 1967, and 1968, respectively. Since 1969, returns have been the progeny of naturally spawning fish and have steadily declined in numbers. The reasons for failure of the transplant are not certain, but possibilities include the following: predation on the fry by brook trout and possibly eels in North Harbour Pond and estuary; unfavorable surface temperatures in the river during the fry run; predation by herring on fry in St. Mary's Bay; year-class failure of the even-year stocks that were introduced; unsuitability of the donor stocks with respect to migration patterns and homing behavior; inadequate numbers of eggs were transplanted to produce populations required to maintain runs in anything below optimum environmental conditions.

75-000653 Vreeland, R. R.; Wahle, R. J.; Arp, A. H. (NMFS, 811 Northeast Oregon St., Portland, OR 97208) HOMING BEHAVIOR AND CONTRIBUTION TO COLUMBIA RIVER FISHERIES OF MARKED COHO SALMON RELEASED AT TWO LOCATIONS. NOAA Fish. Bull. 73 (4): 717-725. Oct. 1975. SFA 20(4).

This study was initiated to determine the feasibility of creating or enhancing fisheries in specific areas by releasing salmon smolts into those areas. In 1970, two groups each of approximately 100,000 1968-brood coho salmon, /Oncorhynchus kisutch/, were marked with a right ventral (RV) or a left ventral (LV) finclip at Little White Salmon National Fish Hatchery near Coos Bay, Wash. The LV-marked group was

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transported by truck to Youngs Bay, 19 km (12 miles) from the mouth of the Columbia River near Astoria, Oreg., and released in April 1970. The RV-marked group was released in May 1970 at Little White Salmon Hatchery, 242 km (150 miles) from the mouth of the Columbia River. The Youngs Bay and Columbia River gill-net fisheries were sampled for these marks in the fall of 1970 and 1971. The two groups homed to their respective areas of release with very little straying. The LV-marked group contributed 7.7 fish to the fisheries sampled for each 1,000 fish released, and the RV-marked group contributed 11.7 fish to the fisheries sampled per 1,000 fish released. However, a fair comparison of the contribution of the two groups is inhibited by 1) incomplete sampling for these marks in the ocean fisheries, 2) the difference in time and size of release of the groups, 3) the unknown effect of delayed mortality due to hauling the LV-marked group, and 4) duplication of these marks in the ocean fisheries.

FISHING GEAR AND TECHNIQUES

75-000654 Collins, J. J. (Minist. Nat. Resour., South Bay Fish. Res. Stn., Tehkummah, ON, Canada) AN EMERGENT FRY TRAP FOR LAKE SPAWNING SALMONINES AND COREGONINES. Prog. Fish-Cult. 37 (3): 140-142. July 1975. SFA 20(4).

An emergent fry trap for lake spawning salmonines and coregonines is described. In laboratory tests the trap caught a minimum of 51 percent (range 48-58 percent) of emerging whitefish fry (*Coregonus clupeaformis*). Catches in South Bay of Lake Huron indicated that whitefish fry emerged from the gravel substrate at water depths of 0.5-3.0 m, the only depth range sampled to date. Emergence spanned a period of at least 13 days in 1971 and 1972, and a minimum of 26 days in the spring of 1973.

75-000655 Ellis, J. E. (U.S. FWS, Fish Farming Exp. Stn., Stuttgart, AR 72160) ELECTROTAXIC AND NARCOTIC RESPONSES OF CHANNEL CATFISH TO VARIOUS ELECTRICAL PULSE RATES AND VOLTAGE AMPLITUDES. Prog. Fish-Cult. 37 (3): 155-157. July 1975. SFA 20(4).

Electrical combinations (pulse rate and voltage amplitude) for eliciting electrotaxic and narcotic responses in small, medium, and large channel catfish (*Ictalurus punctatus*), and general observations on the need for a homogeneous electrical field provided information on the electrical characteristics required for electrofishing. Optimum electrical characteristics varied with size of fish; no single frequency or voltage was equally effective for fish of all sizes. Toxic response was strongest at a frequency of 24 pulses/s with voltage amplitudes ranging from 1.5 to 4.0 for small fish (15-20 cm total length), 1.0 to 3.0 for medium sized fish, and 0.5 to 3.0 for large fish (37-42 cm long). A frequency of 40 pulses/s at various voltage amplitudes was most effective for eliciting a narcotic response.

75-000656 Ellis, J. E. (U.S. FWS, Fish Farming Exp. Stn., Stuttgart, AR 72160) OBSERVATIONS ON ELECTRICALLY SHOCKED CHANNEL CATFISH. Prog. Fish-Cult. 37 (3): 148-149. July 1975. SFA 20(4).

Exposure of channel catfish (*Ictalurus punctatus*) to electrical shocks with pulsed DC of 0.3 and 1.5 V/cm at 60, 90, and 120 s each caused complete narcosis (complete loss of locomotion and sinking to bottom) in some individuals, subnarcosis (loss of equilibrium and feeble swimming at the surface) in other individuals, and no narcosis in others. The number of fish completely narcotized was greater at the

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higher voltage and longer exposure times. Large fish (130-203 mm) were more completely immobilized than smaller fish (77-120 mm). The data suggest that 0.3 V/cm for 60 s would be the most effective for capturing channel catfish in the field, but the use of the electrical shock method introduces bias for population estimates.

75-000657 Gabel, J. A. (U.S. FWS, Ludington, MI 49431) AN EXPERIMENTAL TRAP NET FISHERY, LAKE OAHE, SOUTH DAKOTA, 1965. U.S. Fish Wildl. Serv. Tech. Pap. 82. 9p. 1974. SFA 20(4).

Large trap nets were evaluated as a commercial gear for capturing buffalo fish during July-September 1965. During the 72-day fishing period, 13,171 fish weighing 21,669 kg were taken. Bigmouth buffalo (*Ictiobus cyprinellus*) and smallmouth buffalo (*Ictiobus bubalus*) dominated the catch (78.2 percent by weight). Eight sport species accounted for 3.6 percent of the total catch.

Both 7.0-cm and 12.7-cm mesh (extended measure) were used in the back of the bailing crib of the nets to determine the effect of the 12.7-cm mesh in reducing the catch of sport species and nonmarketable size groups of commercial species. The 12.7-cm mesh reduced the catch of nonmarketable bigmouth buffalo 29 percent, smallmouth buffalo 11 percent, river carpsucker (*Carpionodes carpio*) 18 percent, carp (*Cyprinus carpio*) 8 percent, freshwater drum (*Aplodinotus grunniens*) 35 percent, and sport species 68 percent.

75-000658 Hamley, J. M. (Dep. Biol., Univ. West. Ont., London, ON N6A 3K7, Canada) REVIEW OF GILLNET SELECTIVITY. J. Fish. Res. Board Can. 32 (11): 1943-1969. Nov. 1975. In English with French summ. SFA 20(4).

This paper reviews studies on gillnet selectivity: the relevant characteristics of fish and nets, graphical and mathematical representation of selectivity curves, and methods of estimation. F. I. Baranov started these studies 60 yr ago, and most subsequent work has been consistent with his axioms that a) gillnets catch fish whose head girths are smaller but maximum girths larger than the mesh perimeter, and b) selectivity curves for all mesh sizes have the same shapes and heights. Unfortunately these axioms are inaccurate. The heights of selectivity curves increase with mesh size.

Selectivity depends mainly on fish size and shape and mesh size, but is also affected by the thickness, material, and color of net twine, hanging of net, and method of fishing. The left slopes of selectivity curves represent smaller fish wedged in the meshes; the right slopes, larger fish mainly tangled by head parts. The curves may be very skewed or multimodal for fish that are easily tangled.

The most reliable, though expensive, estimates of gillnet selectivity are by "direct" methods of fishing a population of known size-frequency distribution. The more popular but biased "indirect" estimates compare catches by two or more mesh sizes. Other methods used are prediction from girth measurements and the DeLury method.

75-000659 Nelson, W. R.; Boussu, M. F. (U.S. FWS, P.O. Box 698, Pierre, SD 57501) EVALUATION OF TRAWLS FOR MONITORING AND HARVESTING FISH POPULATIONS IN LAKE OAHE, SOUTH DAKOTA. U.S. Fish Wildl. Ser. Tech. Pap. 76. 15p. 1974. SFA 20(4).

Trawls of various designs and sizes were compared to evaluate their use for monitoring and harvesting fish populations in Lake Oahe. Catches of a 10.7-m semiballoon trawl, selected to monitor changes in the fish populations from 1965 to 1970, showed a downward trend in the abundance of all species, except walleye; the decline was largest in the lower area of the reservoir with a slight increase in the upper area. Of two trawl designs tested, semiballoon trawls captured more

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fish per hour than high-rise trawls, and a 15.9-m semiballoon trawl with a 3.8-cm mesh cod end captured fish at the highest and most consistent rate. The size and species composition of fish caught in small-mesh trawls differed from those caught in trap nets. Trawl catches were too small to recommend or warrant their use as a commercial fishing gear, but the use of both small mesh trawls and trap nets should improve accuracy in monitoring fish populations in this reservoir.

75-000660 Paulson, L. J.; Epinosa, F. A., Jr. (Div. Environ. Stud., Univ. Calif., Davis 95616) FISH TRAPPING: A NEW METHOD OF EVALUATING FISH SPECIES COMPOSITION IN LIMNETIC AREAS OF RESERVOIRS. Calif. Fish Game 61 (4): 209-214. Oct. 1975. SFA 20(4).

Lighted fish traps were suspended in limnetic waters of Las Vegas Bay, Lake Mead, Nevada to evaluate the fish species components of a dense scattering layer. Preliminary results suggested that the scattering layer was composed primarily of young-of-the-year threadfin shad. The lighted traps appear to be an inexpensive, effective means of sampling shad in a scattering layer.

75-000661 Szczerbowski, J.; Jagielka, T.; Sroczynski, S. (Akad. Roln.-Tech., Olsztynie, Poland) BADANIA MOZLIWOSCI ZWIEKSZENIA EFEKTYWNOŚCI POŁOWOW SIELAWY PRZY ZASTOSOWANIU ŚWIATŁA ELEKTRYCZNEGO. [INVESTIGATION INTO THE CHANCE OF INCREASING THE EFFICIENCY OF /COREGONUS ALBULA/ CATCHES WHEN USING THE ELECTRIC LIGHT.] Rocz. Nauk Roln. Ser. H Rybactwo 96 (3): 127-138. 1974. In Polish with English summ. SFA 20(4).

Comparison of results obtained in /Coregonus albula/ catches by gill nets illuminated with electric light and those unilluminated. The illumination of gill nets resulted in a reduction of efficiency of /Coregonus albula/ catches, and in an insignificant damage of the fish caused by the eel in gill nets. (Auth. Synopsis)

MATHEMATICS, STATISTICAL METHODS AND MODELING

75-000662 Argentesi, F.; de Bernardi, R.; di Cola, G. (Joint Res. Cent., CETIS Div., Euratom, Ispra, Italy) MATHEMATICAL MODELS FOR THE ANALYSIS OF POPULATION DYNAMICS IN SPECIES WITH CONTINUOUS RECRUITMENT. Mem. Ist. Ital. Idrobiol. 31: 245-275. 1974. In English with Italian summ. SFA 20(4).

Some mathematical models used in the study of the dynamics of populations with continuous recruitment are presented. The numerical techniques for the estimation of the characteristic parameters (fecundity and mortality rates) are described and discussed.

Finally, a wide field of application to experimental data related to zooplanktonic populations is presented.

75-000663 Clark, R. D., Jr.; Lackey, R. T. (Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA 24061) COMPUTER-IMPLEMENTED SIMULATION AS A PLANNING AID FOR STATE FISHERIES MANAGEMENT AGENCIES. Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA. vi + 179p. 1975. SFA 20(4).

A basic job of fisheries management agencies is to forecast the demand and produce the necessary supply of fishing opportunities. Present day angling consumption rates often exceed managers' ability to supply fishing opportunities of the desired quality. Therefore, a primary means for improving fisheries management may be to regulate angling consumption. Operations research techniques are well suited

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for handling the complexities involved with planning multiple action policies for regulating angler consumption.

PISCES is a computer-implemented simulator of the inland fisheries management system of Tennessee, but is adaptable for use in any state. The purpose of PISCES is to aid in planning fisheries management decision policies at the macro-level. PISCES generates predictions of how fisheries management agency activities will affect angler use for a fiscal year. Subjective probability distributions for random variables and Monte Carlo simulation techniques are employed to produce an expected value and standard deviation for each prediction. Test runs under realistic hypothetical situations and discussions with personnel of Tennessee Wildlife Resources Agency suggest that PISCES may help fisheries management agencies to improve budget allocation decisions, to formulate multiple action policies for regulating angler use, and to enhance fisheries development. A hypothetical application of PISCES in Tennessee is given.

75-000664 Lackey, R. T. (Dep. Fish. Wildl. Sci., VPI RECREATIONAL FISHERIES MANAGEMENT & ECOSYSTEM MODELING. Presented at the Symposium Comparison of Biological Predation and Fisheries Exploitation sponsored by the Aquatic Ecology Section of the Ecological Society of America and the American Fisheries Society, 26th Annual American Institute of Biological Sciences Meeting of Biological Societies, Corvallis, Oregon, August 17-22, 1975. 44p. Aug. 1975. SFA 20(4).

Fisheries management is the practice of analyzing, making and implementing decisions to maintain or alter the structure, dynamics, and interactions of habitat, aquatic biota, and man to achieve human goals and objectives through the aquatic resource. The purpose of this article is to place ecosystem modeling into a fisheries management framework, specifically as appropriate to recreational fisheries management. Recreational fisheries are especially complex, but prediction is the essence of fisheries management. Managers usually predict the consequences of a proposed decision in a number of ways including rules of thumb, past experience, population models, experimentation, trial and error, and pure guess. A key problem in making accurate predictions of the consequences of a proposed management decision is the complexity of most fisheries. Arithmetical calculation has been the major problem with using mathematical models in fisheries management. This problem has been solved to some degree by "simulating" fisheries.

Most fisheries and ecosystem models are quite similar in approach and philosophy, but there is substantial variation between models when viewed according to their intended use or function. Models used in fisheries may be classified as to habitat, biological, or social type, or combinations of the three categories. Fisheries, when viewed in the broadest sense, includes habitat, biological, and social aspects. The future role of modeling in recreational fisheries management may or may not be great and depends in large measure on the relationship between "modelers" and "decision-makers."

75-000665 Lackey, R. T. (Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA 24061) COMPUTER APPLICATIONS IN FISHERIES SCIENCE. Trans. Am. Fish. Soc. 104 (3): 589-590. July 1975. SFA 20(4).

Most uses of computers in fisheries science can be categorized as (1) data tabulation, processing, and analysis; (2) automated and semi-automated monitoring systems; (3) educational, especially at the university level; (4) simulation to evaluate management strategies; (5) simulation to learn basis system properties, especially ecological interrelationships; or (6) facilitation of numerical analysis. A problem in renewable natural resource management is determining when and how the use of computer technology is warranted.

75-000666 Lackey, R. T. (Dep. Fish. Wildl. Sci., VPI & SU, Blacksburg, VA 24061) FISHERIES AND ECOLOGICAL MODELS IN FISHERIES RESOURCE MANAGEMENT. in C. S. Russel, ed. Ecological Modeling. NOAA and Resources for the Future. 241-249. 1975. SFA 20(4).

75-000667 Laurent, M.; Lamargue, P. (Stn. Hydrobiol., I.N.R.A., B.P. 79, 64200 Biarritz, France) UTILISATION DE LA METHODE DES CAPTURES SUCCESSIVES (DE LURY) POUR L'EVALUATION DES PEUPELEMENTS PISCICOLES. [UTILIZATION OF THE DE LURY METHOD BY SUCCESSIVE CAPTURES FOR THE ESTIMATION OF FISH STOCKS.] Ann. Hydrobiol. 5 (2): 121-132. 1974. In French with English summ. SFA 20(4).

The De Lury method by successive captures has been used for the estimation of three types of fish stocks. The results obtained with two and three fishing runs are compared; the Petersen method by capture-recapture has also been compared with the two fishing runs method.

On the whole, this study shows that the Petersen method should be used with low efficiencies and little stocks. According to the strict statistical conditions to be worked out with the De Lury method, it seems advisable to use it for high efficiencies or large stocks.

A way of proceeding is proposed, which is based on the relative importance of captures, for working out the fish inventories with the De Lury method.

75-000668 Palm, W. J. (Dep. Mech. Eng., Univ. R.I., Kingston 02881) FISHERY REGULATION VIA OPTIMAL CONTROL THEORY. NOAA Fish. Bull. 73 (4): 830-837. Oct. 1975. SFA 20(4).

This paper attempts to show how control theory can be used to formulate a regulatory scheme for fisheries. The regulatory mechanism considered is a limit imposed on fishing effort. It is shown that static optimization methods, such as maximum equilibrium yield analysis, need to be supplemented with dynamic methods, such as optimal control theory, which take into account the variable nature of a fishery. The dynamic analysis is used to show that the size of a limit on effort should be a feedback function of the variables in the state of the fishery. The concept of the Linear-Quadratic Optimal Control Problem is introduced as a method for devising such a feedback scheme for fishery regulation.

A single-variable logistic model is used to introduce the basic concepts. A model with three variables is then analyzed to show how the techniques are easily extended to the general multivariable case. Details of the general method are given in an Appendix.

75-000669 Parrish, J. D. (Mass. Coop. Fish. Unit., 204 Holdsworth Hall, Univ. Mass., Amherst 01002) MARINE TROPHIC INTERACTIONS BY DYNAMIC SIMULATION OF FISH SPECIES. NOAA Fish. Bull. 73 (4): 695-716. Oct. 1975. SFA 20(4).

A mathematical model was developed for performing dynamic simulations of groups of interacting animal species. The energy balance of the individual animal was modeled so that growth and reproduction respond to food consumption after metabolic expenses are met. Populations change in response to recruitment (based on parental spawning) and mortality from natural causes, predation, starvation, and (where applicable) human exploitation. The forms of the various component mathematical functions were derived from the available ecological sources. Functions and parameters are especially applicable to marine fish species. Trophic webs of any size or form can be constructed using this basic species model. Computer solution of the

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essentially continuous differential model gives a time history of trophic and population variables for all species in the web.

Models of trophic webs of 2, 3, and 4 levels were constructed and exercised. These were used to examine effects of age class structure, reproductive time lag, and population regulation by starvation mortality and fecundity control. Competition between species and the effects of a top predator on competitors, with and without human exploitation, were studied.

75-000670 Patten, B. C. (Dep. Zool., Univ. Ga., Athens 30602) A RESERVOIR COVE ECOSYSTEM MODEL. Trans. Am. Fish. Soc. 104 (3): 596-619. July 1975. SFA 20(4).

A total ecosystem compartment model of a reservoir cove is described, with emphasis on the fish submodel. Nominal (unperturbed) annual cycles of selected compartments are presented, and results from three perturbation experiments (thermal pollution, eutrophication, piscivore invasion) are summarized. The ability of fishes to influence structure and function of the entire ecosystem (model) is demonstrated, and the role of top trophic levels in controlling the design of ecological communities is discussed. The status and prospects of total ecosystem modeling as a tool for fisheries science are considered.

75-000671 Saila, S. B.; Hess, K. W. (Mar. Exp. Stn., Univ. R.I., Kingston 02881) SOME APPLICATIONS OF OPTIMAL CONTROL THEORY TO FISHERIES MANAGEMENT. Trans. Am. Fish. Soc. 104 (3): 620-629. July 1975. SFA 20(4).

A review is made of some optimization techniques applied to fisheries and related problems. Explanation of optimal control theory as applied to the Schaefer or logistic model and to the Beverton and Holt model are provided. An optimal policy for a fishery management model based on the Brody growth function is developed. The control variable in each of the above examples is the rate of fishing and the objective function is the maximum biomass yield. A method for estimating the parameters of the Brody growth function is illustrated for the albacore tuna.

75-000672 Wallace, D. N. (Power Auth. State N.Y., 10 Columbus Circle, New York 10019) A CRITICAL COMPARISON OF THE BIOLOGICAL ASSUMPTIONS OF HUDSON RIVER STRIPED BASS MODELS AND FIELD SURVEY DATA. Trans. Am. Fish. Soc. 104 (4): 710-717. Oct. 1975. SFA 20(4).

In 1974, major decisions about the estimated impact of power plants along the Hudson River were reached by courts and regulatory agencies. These cases featured several striped bass models as tools for impact assessment. Many of the models were based on assumptions relative to distribution, transport, and behavior of early life stages of striped bass. However, data from the 1965-1968 Hudson River Fisheries Investigation, the 1969-1970 Raytheon Survey, the 1971-1972 New York University ichthyoplankton study, the 1973 Texas Instruments Hudson River Fisheries Survey, and surveys in other striped bass estuaries do not support the assumptions of most of the models. Recommendations for use of models in decision-making are offered.

75-000673 Walter, G. G. (Dep. Math. Cent. Great Lakes Stud., Univ. Wis., Milwaukee 53201) GRAPHICAL METHODS FOR ESTIMATING PARAMETERS IN SIMPLE MODELS OF FISHERIES. J. Fish. Res. Board Can. 32 (11): 2163-2168. Nov. 1975. In English with French summ. SFA 20(4).

A graphical method for calculating the coefficients for a Schaefer model of a fishery is introduced. It involves plotting catch per effort vs. effort data and then correcting the values for disequilibrium of the fishery. A hypothetical and a realistic example are presented.

75-000674 Youngs, W. D.; Robson, D. S. (Dep. Nat. Resour., Cornell Univ., Ithaca, NY 14853) ESTIMATING SURVIVAL RATE FROM TAG RETURNS: MODEL TESTS AND SAMPLE SIZE DETERMINATION. J. Res. Fish. Board Can. 32 (12): 2365-2371. Dec. 1975. In English with French summ. SFA 20(4).

This paper brings to the attention of fishery biologists a method of estimating survival and exploitation rates when a series of tag recaptures from angler-killed fish is available; this model is appropriate only for recaptures that are removed from the population. Tests for the appropriateness of the model and methods for determining sample size are presented. The test for the model is imperative since estimates of survival would be meaningless if data do not conform to model.

LAKE MANAGEMENT & RESEARCH

75-000675 Makowecki, R. (Alberta Lands and Forests, Natural Resources Bldg., 109th St. & 99th Ave., Edmonton, AB T5K 2E1, Canada) THE TROPHY PIKE, /*ESOX LUCIUS*/, OF SEIBERT LAKE, ALBERTA. MS thesis, Univ. Alberta, Edmonton 239p. 1973. SFA 20(4).

Seibert Lake has a history of very large northern pike. Because of this characteristic, it was designated a trophy lake in 1970. The purpose of the study was to determine reasons for the pronounced growth of pike and to determine methods of managing the fishery for the future.

The lake whitefish (/Coregonus clupeaformis/) population appears to be large in number but relatively small in size (few fish exceeding two pounds). The whitefish are distributed to a large extent in the littoral region and this is indicative of their diet and of their position in the trophic structure.

The walleye (/Stizostedion vitreum/) population like the whitefish population seems to be large in number but relatively small in size. Again like the whitefish the walleye converge upon the littoral region for their food supply; thus their diet overlaps with that of the whitefish. The usual fish diet of walleye is not the case in Seibert since few forage fish appear to be present.

The pike (/Esox lucius/) population is small in number but with relatively large-sized individuals. Small pike have diets similar to walleye and whitefish and show a rather inhibited growth rate to the age of five. Sexual dimorphism is very pronounced, thus males continue to grow slowly. The factors most responsible for pike growth include: low pike production, certain vegetative types and their associations and a whitefish population which is available, appropriate, abundant and desirable as the major food item for large pike.

A strong positive correlation exists between pike abundance and vegetation quality. The most important vegetation types for large pike include /Nuphar variegatum/, /Potamogeton praelongus/ and /Potamogeton natans/. Pike abundance correlates poorly ($r = +.24$) with abundance of bottom fauna.

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Greater than 60 per cent of the pike come from two areas and 90 per cent of the large pike come from these areas which are of prime habitat. Most pike show little movement but those that move seem to move from poor habitat to better habitat.

With increasing interest in the trophy lakes a greater pressure is placed upon the relatively small numbers of trophy pike. To maintain the trophy fishery for the future, restrictions must be placed upon the techniques used in capturing fish so as to reduce mortality of fish being released and regulations must be instituted to reduce total numbers of trophy pike being removed. --From abstr.

75-000676 Marciak, Z. (Inst. Rybactwa Srodladowego, Olsztyn-Kortowo, Poland) TYPY WZROSTU JAKO PODSTAWA OKRESLANIA WYMIAROW GOSPODARCZYCH DLA POPULACJI LESZCZA W JEZIORACH. [GROWTH TYPES AS A BASIS FOR DETERMINATION OF ECONOMIC SIZES OF BREAM POPULATIONS IN THE LAKES.] Roczn. Nauk Roln. Ser. B Rybactwo 96 (3): 97-109. 1974. In Polish with English summ. SFA 20(4).

S-shaped curve of weight growth of bream was stated and its four types were distinguished by Marciak. These types differed from the average growth and, according to the S-shaped Bartalanffy's model curve, corresponded with the attained extremal age and size. In the present paper, significant differences in age and size attained by populations of various growth types were found on the basis of age and size of the largest fish that had been caught. For these populations, separate legal sizes (the so-called "economic sizes") were established. The following criteria for determination of the legal sizes were used:

(1) Mean individual weight of fish at the moment when a generation attains its maximum biomass (according to Baranov), which was calculated on the basis of mean growth attained by fish of a given growth type in eutrophic lakes at the assumed natural mortality rate $M = 0.2$;

(2) Production/biomass ratio (P/B), calculated from the mean individual growth as a quotient of weight increase in successive years of life and mean individual weight in the same years. P/B coefficient was considered to be an indicator of costs of maintenance of an organism and an indicator balancing gain against loss caused by the same natural mortality in the generation biomass budget;

(3) Percentage of lakes of a given limnological type in which particular growth types occur. In the lakes of different limnological types occur various fishery conditions that produce different catching mortality (this is a criterion to be taken into account when estimating a recruitment measure to obtain the maximum yield, according to Beverton and Holt). Considering this, "economic sizes" for particular growth types were accepted to be attained 1-2 years before the age of maximum biomass of a generation. Additionally, it was suggested to make selective catches of fish that were close to attain their final size for a given growth type and that attaining low values of P/B coefficient. When low the latter testified to high costs of maintenance and balanced insufficiently a loss caused by natural mortality in the generation biomass budget. (Auth. Summ.)

75-000677 Marciak, Z. (Inst. Rybactwa Srodladowego, Olsztyn-Kortowo, Poland) WPLYW CZYNNIKOW LIMNOLOGICZNYCH I RYBACKICH NA WZROST I POLOWY LESZCZA W JEZIORACH ROZNYCH TYPOW. [THE EFFECT OF LIMNOLOGICAL AND FISHING FACTORS UPON THE GROWTH AND CATCHES OF BREAM IN THE LAKES OF DIFFERENT TYPE.] Rocz. Nauk Roln. Ser. H Rybactwo 96 (3): 57-74. 1974. In Polish with English summ. SFA 20(4).

Growth rates of bream in 576 lakes destined for economic management were examined and 15 limnological factors affecting growth including data on fish catches were compiled. Influence of these factors on bream catch sizes and on four indices of bream growth was studied with the use of multiple correlation method. The growth indices were as follows: growth of juveniles at the period of potential planktonophagous fish; growth of adult bream (less than 750 g in weight) at the period of specialized benthophagous fish before they became potential molluscophagous fish; the weight at which bream growth was slackened, i.e. an inflection point of the S-shaped weight growth curve; and fish condition.

Only statistically significant dependences at the levels of 0.1 and 0.01 were analysed.

Considering all the factors that significantly influenced bream growth in particular life periods and catch sizes, the following should be emphasized:

(a) Influence of morphometry, fertility, active bottom area, plankton density, and transparency on juvenile growth and fish condition;

(b) Influence of a number of vegetation days in the season on growth of juvenile and adult fish--mainly in eutrophic lakes;

(c) Remarkable correlation of growth of juvenile and adult fish and their growth inflection with catches of bream, roach, tench and the average catch and with percentage of large fish in a catch;

(d) Marked dependence of bream catches on lake morphometry, fish growth, catches of other fish species and percentage of large fish in a catch; minor dependence on the factors affecting primary production.

Separate ecological conditions, as concerned catch sizes and growth of bream in its successive life periods, were realized in particular lake types. In a-mesotrophic and b-mesotrophic lakes no limnological factor inhibited or stimulated growth prominently while in pond-like and eutrophic lakes bream growth depended on a number of coinciding significant factors. In eutrophic lakes growth and catches of bream showed distinct dependence on morphometry and a number of vegetation days in the season. In pond-like lakes remarkable dependence of growth and catches of bream on indices of catches of bream, roach, tench and the average catch and on percentage of large fish in a catch was observed. (Auth. Summ.)

RIVER AND STREAM MANAGEMENT & RESEARCH

75-000678 Brandt, T. M.; Schreck, C. B. (Dep. Grain Sci. Ind., Kans. State Univ., Manhattan 66506) EFFECTS OF HARVESTING AQUATIC BAIT SPECIES FROM A SMALL WEST VIRGINIA STREAM. Trans. Am. Fish. Soc. 104 (3): 446-453. July 1975. SFA 20(4).

The potential impact of commercial bait harvest from small streams was studied in Rich Creek, West Virginia. A mail survey and personal interviews of bait dealers in the mountain areas of this state established typical harvest pressures exerted by commercial operations. Bait fish and crayfish in 50-m sections of Rich Creek were harvested three times every two weeks from May 15 until September 15, 1973, via seine and minnow traps. Treatments consisted of no harvest, a harvest simulating a typical bait dealer, and a harvest pressure twice that of a commercial dealer; all treatments were in triplicate.

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The effects of the harvests were determined by comparisons over time within treatments, comparisons between treatments and comparisons with final population indices. No significant differences in these comparisons were found to occur for the bait species or for the game fish species inhabiting the study sections. The different harvesting pressures did not appear to affect the densities of the bait and game fish populations.

75-000679 Walters, C. J. (Inst. Anim. Resour. Ecol., Univ. British Columbia, Vancouver, BC, V6T 1W5, Canada) OPTIMAL HARVEST STRATEGIES FOR SALMON IN RELATION TO ENVIRONMENTAL VARIABILITY AND UNCERTAIN PRODUCTION PARAMETERS. J. Fish. Res. Board Can. 32 (10): 1777-1784. Oct. 1975. In English with French summ. SFA 20(4).

A method is developed for incorporating the effects of environmental variability and judgemental uncertainty about future production parameters into the design of optimal harvest strategies; these are expressed as curves relating stock size and exploitation rate. For the Skeena River sockeye, the method suggests that optimal strategies are insensitive to judgmental uncertainty about the Ricker stock production parameter, but are very sensitive to management objectives related to the mean and variance of catches. Best possible tradeoffs between mean and variance of catches for the Skeena River are developed, and a simplified strategy is suggested for improving mean catch while reducing year to year variation.

FARM POND AND SMALL IMPOUNDMENT MANAGEMENT

75-000680 Dillard, J. G. (Mo. Dep. Conserv., P.O. Box 180, Jefferson City 65101) MISSOURI POND HANDBOOK Mo. Dep. Conserv., Jefferson City iv + 60p. Apr. 1975. SFA 20(4).

A popularly written handbook on farm pond construction and management in Missouri. (RS)

LARGE IMPOUNDMENT MANAGEMENT & RESEARCH

75-000681 Benson, N. G.; Hudson, P. L. (North Central Reservoir Invest., Yankton, SD 57078) EFFECTS OF A REDUCED FALL DRAWDOWN ON BENTHOS ABUNDANCE IN LAKE FRANCIS CASE. Trans. Am. Fish. Soc. 104 (3): 526-528. July 1975. SFA 20(4).

Lake Francis Case, a 356-km² Missouri River reservoir, is drawn down each fall to hold water released from upstream for winter power generation. The customary drawdown of 10-12 m in 1953-70 was reduced to 6-7 m in 1971-73. Benthos samples collected from 1966 to 1973 indicated that abundance of benthic organisms in May along two transects (to depths of 10.5 and 15 m) increased more than threefold after the drawdown was reduced; abundance in September did not increase. May increases were most evident for five burrowing forms: chironomids, /Hexagenia/, /Caenis/, oligochaetes, and ceratopogonids.

75-000682 Gabel, J. A. (U.S. FWS, North Cent. Reservoir Invest., Mobridge, SD 57601) SPECIES AND AGE COMPOSITION OF TRAP NET CATCHES IN LAKE OAHE, SOUTH DAKOTA, 1963-67. U.S. Fish Wildl. Serv. Tech. Pap. 75. 21p. 1974. SFA 20(4).

Twenty-seven fish species were captured in Lake Oahe with trap nets in 1963-67. The catch was dominated by eight species in order of abundance: black crappie (*Pomoxis nigromaculatus*), bigmouth buffalo (*Ictiobus cyprinellus*), white crappie (*Pomoxis annularis*), carp (*Cyprinus carpio*), river carpsucker (*Carpionodes carpio*), freshwater drum (*Aplodinotus grunniens*), smallmouth buffalo (*Ictiobus bubalus*), and goldeye (*Hiodon alosoides*).

Catch per unit of effort did not reflect changes in abundance of some of the species because of variation in environmental conditions. Frequency and strength of postimpoundment year classes were considered the best indicators of the ability of a species to adapt to reservoir conditions.

Northern pike (*Esox lucius*), carp, smallmouth buffalo, and bigmouth buffalo established strong year classes in the early years of impoundment (1952-62), when previously unflooded terrain was inundated as the reservoir filled. The infrequency of abundant postimpoundment year classes and the limitations caused by spawning habitat requirements indicated that the abundance of these species will decline. Goldeye, channel catfish (*Ictalurus punctatus*), white bass (*Morone chrysops*), white crappie, black crappie, sauger (*Stizostedion canadense*), yellow perch (*Perca flavescens*), and freshwater drum which do not require inundated vegetation for spawning had better reproductive success after 1962 than before.

75-000683 June, F. C. (U.S. FWS, P.O. Box 698, Pierre, SD 57501) ECOLOGICAL CHANGES DURING THE TRANSITIONAL YEARS OF FINAL FILLING AND FULL IMPOUNDMENT (1966-70) OF LAKE OAHE, AN UPPER MISSOURI RIVER STORAGE RESERVOIR. U.S. Fish Wildl. Serv. Tech. Pap. 71. 57p. 1974. SFA 20(4).

This paper gives synoptic data and trends on water discharge, water level, sedimentation, turbidity, transmissivity, temperature, specific conductance, dissolved oxygen, and plankton. Correlations indicate the nature of some apparent interactions between the plankton and certain of these environmental variables.

Notable changes in the water regimen included the water volume, outflow rate, and level. The total annual discharge volume and the mean discharge rate increased by about 35 percent. Water residence time within the reservoir was thus reduced after filling, and the increase in outflow was greatest during the summer. Water level rose in successive years and reached operational level in 1967. Annual fluctuations in level ranged from 2.8 to 5.9 m and averaged 3.9 m.

Aside from inundation, sediment deposition was the most obvious physiographic change in the reservoir. Sediments have largely obliterated the old river channel and were heaviest in the lower third of the reservoir. Continual slumping of Pierre shale banks along the west shore was one of the chief processes responsible for sediment additions.

There also were notable changes in some physical properties of the water. Turbidity decreased, particularly in the upper half of the reservoir. Transmissivity increased and was greatest in the lower half of the reservoir. The temperature of outflow water decreased 2 to 3 C during the summer, and attainment of maximum temperature was delayed by about a month after filling. The lower two-thirds of the reservoir became thermally stratified in every year, but the pattern and details of stratification varied according to the prevailing water-discharge pattern. Increases in specific conductance were associated with increases in water level. Dissolved oxygen concentrations were usually near saturation, and there was little year-to-year variation.

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The phytoplankton standing stock consisted mostly of diatoms. Abundance was generally low and decreased from 1966 to 1968. The zooplankton standing stock was composed mainly of copepods and cladocerans. The number of zooplankton genera appeared to increase, whereas abundance decreased after filling. The post-filling decline in the abundance of zooplankton was, in part, associated with an increase in water discharge.-- From abstr.

75-000684 Miller, G. L.; Nelson, W. R. (U.S. FWS, North Cent. Reservoir Invest., Pierre, SD 57501) GOLDEYE, /HIODON ALOSOIDES/, IN LAKE OAHE: ABUNDANCE, AGE, GROWTH, MATURITY, FOOD, AND THE FISHERY, 1963-69. U.S. Fish Wildl. Serv. Tech. Pap. 79. 13p. 1974. SFA 20 (4).

Reproductive success was relatively consistent, and adequate to maintain species abundance at a nearly constant level, during 1963-69. Both abundance and growth in length increased from the lower to the upper portion of the reservoir. In most characteristics--growth in length, length-weight relation, age at maturity, and food--goldeye in Lake Oahe were similar to those from other Missouri River impoundments.

Experimental gill nets sampled all lengths (range 80-460 mm; median, 320 mm) of goldeye, bottom trawls sampled mostly small fish, (median, 215 mm) and trap nets large ones (median, 345 mm). Commercial gill nets were highly size selective (median, 375 mm); fish of ages IV-VII made up 90 percent of the catch. Survival rates were 57 to 52 percent for ages II-X. Estimated survival rates for ages V-IX declined from 44 to 35 percent after the inception of the commercial fishery in 1966. The peak commercial catch was 151,432 kg (1.2 kg/hectare) in 1969. Unless recruitment declines, the population can support a fishery of that magnitude.

75-000685 O'Heeron, M. K., Jr.; Ellis, D. B. (Computer Cent., Dickinson Coll., Carlisle, PA 17013) A COMPREHENSIVE TIME SERIES MODEL FOR STUDYING THE EFFECTS OF RESERVOIR MANAGEMENT ON FISH POPULATIONS. Trans. Am. Fish. Soc. 104 (3): 591-595. July 1975. SFA 20 (4).

We describe a linear modeling technique that derives functions (parameters) of the predictor variables in a tabular form using a Fourier transformation technique. The result is a complex multiple regression model that is actually a series of models independently describing each parameter. This technique (1) provides an approximation to nonlinear modeling that is not restricted to a small number of variables, (2) does not require precisely formulated theoretical functions for each variable, and (3) avoids many of the restricting assumptions normally required for nonlinear modeling. The estimate of the total systematic information (variance) in the system and the amount of information predicted by the model can be used as a measure of the efficacy of the model. A production form of the model is being completed for use on the Missouri River mainstem reservoir system for predicting the effects of reservoir management practices on the indigenous fish populations.

75-000686 Ryder, R. A.; Henderson, H. P. (Minist. Nat. Resour., Thunder Bay, ON P7B 5E7, Canada) ESTIMATES OF POTENTIAL FISH YIELD FOR THE NASSER RESERVOIR, ARAB REPUBLIC OF EGYPT. J. Fish. Res. Board Can. 32 (11): 2137-2151. Nov. 1975. In English with French summ. SFA 20(4).

Available biological and hydrographic information on Lake Nasser was examined to provide guidelines for future development of the fisheries. Not enough consistent data were available to allow precise estimates of fishing-stock interrelations; however, an approximation of potential yield was derived from subjective evaluation of limnological characteristics of the lake. Morphoedaphic factors were utilized to establish a numerical expectation of yield in relation to other tropical lakes and reservoirs. Two other models based on estimated zooplankton biomass and an assumed net gain in productivity in Lake Nasser at the expense of a yield loss to the Mediterranean fishery provided order-of-magnitude agreement. Potential yield estimates for Lake Nasser (including its southern portion, Lake Nubia, Sudan) were 23,000 metric tons (MT) of fish annually, providing the reservoir fills to its expected maximum (180 m), or 12,000 MT if it remains at its 1973 level of about 160 m. These estimates are considered sufficiently reliable to guide future development of the fishery.

There is little evidence to support the existence of stock overexploitation. *Tilapia nilotica*, however, the major species entering the fishery, has been subjected to potentially damaging fishing practices on its breeding grounds. These practices combined with water level drawdown, inadvertently timed to perturb *Tilapia*/fry inhabiting the shallow nursery areas, may unduly stress a prime species largely responsible for the current success of the fishery.

Management recommendations for the Nasser-Nubia Reservoir include a regular program of monitoring both stocks and harvest, especially for *Tilapia*. Development emphasis should be placed on improving the logistics of the fishery rather than increasing the number of fishermen, at least until the lake area expands substantially.

MARINE MANAGEMENT & RESEARCH

75-000687 Regier, H. A.; McCracken, F. D. (Univ. Toronto, Toronto, ON, M5S 1A1, Canada) SCIENCE FOR CANADA'S SHELF-SEAS FISHERIES. J. Fish. Res. Board Can. 32 (10): 1887-1932. Oct. 1975. In English with French summ. SFA 20(4).

From an analysis of major national and international policy issues we judge that a vast cultural and political transformation is now underway. In particular, the common property--open access--willing consent regime towards fisheries development and management will be replaced by some workable alternative. For example, a system of national quotas based on stock by stock total allowable catches, subject to an overall constraint of "full utilization," will likely be found to be impractical. These and related aspects are elaborated for fisheries, and apply also to other resource and environmental issues. Scientific information and research programs must obviously relate to such developments.

Canada is reasonably well endowed with conventional scientific and technical competence on fisheries matters. Important and potentially useful innovative science has languished recently; appropriate institutional infrastructures and planning processes to stimulate and direct fisheries science within the country have been absent for several years. Scientific services on the whole remain unorganized. Given these circumstances our recommendations are aimed toward development of perspectives and mechanisms that will help set the

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scientific process in motion into new directions where necessary. The major "gap in knowledge" relates to the inability of so many conventional disciplined scientists to understand other disciplines' approaches and we propose a variety of means by which such constraints may be relaxed.

We recommend that 1) separate foci be identified and appropriate infrastructures be developed for carefully planned transdisciplinary programs in: mapping; monitoring; management-harvest protocols; and modeling research involving synthesis, experimentation, and simulation. 2) New fisheries policies and agency infrastructures now developing should include the capability to undertake sophisticated experimental management on an ongoing basis. 3) Some further explicit division of labor is advisable, within the group of scientific and technical personnel, to produce three sets: technical experts whose work is dictated by programs; mission-oriented generalists to take the lead in planning and directing scientific information services and research activities with special accountability responsibilities; and self-directed creative scientists to innovate and ruminate. 4) Scientific credibility, now slumping, must be recaptured--in part by insulating key scientists from direct political involvement within national and international decision-making. 5) Canada's sea-going research capability is lagging behind that of some other nations and must be enhanced accordingly. These practical recommendations all relate to the five aspects of the broad perspective sketched earlier. The recommendations are not listed in priority sequence and we advise that action should now proceed on all of them. (From Auth. Abstr.)

75-000688 Yoshida, H. O. (NMFS, Southwest Fish. Cent. Honolulu Lab., Honolulu, HI 96812) THE AMERICAN SAMOA LONGLINE FISHERY, 1966-71. NOAA Fish. Bull. 73 (4): 747-765. Oct. 1975. SFA 20(4).

Aspects of the longline fishery based at American Samoa covering the period from 1966 to 1971 are described. The fishery is discussed primarily as it relates to the albacore, *Thunnus alalunga*, and to a small extent the yellowfin tuna, *T. albacares*. The landings of albacore fluctuated between 17,722 and 28,310 metric tons from 1966 to 1971. Although no downward trend was evident in the relation between total landings and total effort, the relation between CPUE (catch per unit of effort) and effort showed a definite downward trend. Generally, fishing effort was confined to the north of lat. 20°S in the first and fourth quarters. In the second and third quarters large amounts of effort were also expended south of lat. 20°S. The length-frequency distribution of albacore showed that albacore sizes were stratified by latitude. North of lat. 20°S the size of albacore was rather uniform, in that only a single mode was evident in the length-frequency distributions. South of lat 20°S two or more modes were evident.

MISC. TECHNIQUES AND EQUIPMENT

75-000689 Cripe, C. R.; Cripe, J. H.; Livingston, R. J. (Dep. Biol. Sci., Fla. State Univ., Tallahassee 32306) APPARATUS FOR THE QUANTITATIVE DETERMINATION OF LOCOMOTOR ACTIVITY PATTERNS OF AQUATIC ORGANISMS USING INFRARED LIGHT-EMITTING DIODES. J. Fish. Res. Board Can. 32 (10): 1884-1886. Oct. 1975. In English with French summ. SFA 20(4).

Photoelectric methods of measuring the activity of aquatic organisms allow unrestrained movement of the animal being studied but may disrupt exogenously controlled rhythms if the light is visible. An apparatus is described that uses infrared light-emitting diodes that

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eliminate some of the problems associated with incandescent light sources. A graph of the locomotor activity data of two pigfish (*Orthopristis chrysoptera*) which was produced by this apparatus is included.

75-000690 Fickeisen, D. H.; Schneider, M. J.; Montgomery, J. C. (Battelle Northwest, P.O. Box 999, Richland, WA 99352) A COMPARATIVE EVALUATION OF THE WEISS SATUROMETER. Trans. Am. Fish. Soc. 104 (4): 816-820. Oct. 1975. SFA 20(4).

The Weiss saturometer, an instrument which measures dissolved gas tensions, was evaluated and compared with gas chromatographic apparatus. With vigorous shaking the saturometer equilibrated with dissolved gas tension only after fifteen to twenty-five minutes in moderately supersaturated water. Paired analyses by gas chromatography and the saturometer did not differ significantly. Both methods (gas chromatography and the Weiss saturometer) appear to offer advantages in specific applications, and the method of choice for dissolved gas analysis remains dependent on individual requirements. The need for conscientious operation of the saturometer by an experienced operator was apparent.

75-000691 Fry, D. H., Jr. (Calif. Dep. Fish Game, Sacramento 95814) MEASURING SALMON, AN OLD AND UNFAMILIAR METHOD. Calif. Fish Game 61 (4): 247. Oct. 1975. SFA 20(4).

75-000692 Lawler, A. R. (Gulf Coast Res. Lab., Ocean Springs, MS 39564) A PORTABLE EXHAUST FOR LABORATORY FUMES. Prog. Fish-Cult. 37 (3): 166-167. July 1975. SFA 20(4).

A portable exhaust system for laboratory fumes is described. The main components of a squirrel cage fan, funnel, and flexible galvanized truck exhaust pipe are housed in a wooden box. The system has been used for 3 years, successfully exhausting formalin fumes from containers as large as 30 gal.

75-000693 Walker, R. B.; Goodyear, P. (Teledyne Brown Eng., Huntsville, AL 35807) A PORTABLE HYDROSTATIC PRESSURE UNIT. Prog. Fish-Cult. 37 (4): 240. Oct. 1975. SFA 20(4).

75-000694 Weimer, R. T.; Ehrenberg, J. E. (Dep. Electr. Eng., Univ. Wash., Seattle 98195) ANALYSIS OF THRESHOLD-INDUCED BIAS INHERENT IN ACOUSTIC SCATTERING CROSS-SECTION ESTIMATES OF INDIVIDUAL FISH. J. Fish. Res. Board Can. 32 (12): 2547-2551. Dec. 1975. In English with French summ. SFA 20(4).

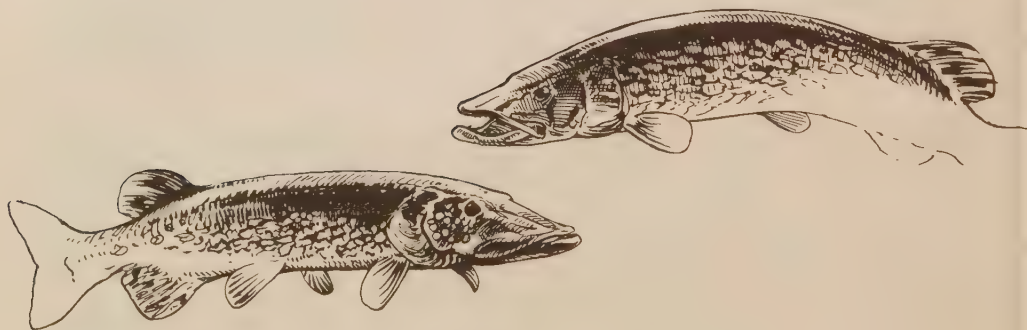
During acoustic fish stock assessment surveys, it is often desirable to measure the distribution of the acoustic scattering cross-section of single fish. One of the problems in such measurements is that a threshold in the electronic circuitry discriminates against small fish. This effect is analyzed in detail, and an expression is derived for the threshold-induced bias in the mean scattering cross-section estimate. Results are plotted for a typical set of operating conditions.

REVIEWS, BIBLIOGRAPHIES, ETC.

75-000695 Intergovernmental Oceanographic Commission (Unesco, 7, Place de Fontenoy, 75700 Paris, France) ANNOTATED BIBLIOGRAPHY OF TEXTBOOKS AND REFERENCE MATERIALS IN MARINE SCIENCES. PROVISIONAL EDITION. Inergov. Oceanogr. Comm. Tech. Ser. 109p. 1975. SFA 20 (4);

The purpose of this publication is to guide educational and research institutions, especially in those countries where the marine sciences are less developed, in the selection of library materials. Hopefully this bibliography will also be of use to teachers and students, as curricula in the marine sciences are developed. (From Auth. Intro.)

75-000696 Marshall, K. E. (Fish. Mar. Serv., Freshwater Inst., Winnipeg, MB, Canada) AN INDEX TO THE PUBLICATIONS OF THE STAFF OF THE FRESHWATER INSTITUTE, WINNIPEG; THE BIOLOGICAL STATION AND TECHNOLOGICAL UNIT, LONDON; AND THE CENTRAL BIOLOGICAL STATION, WINNIPEG; 1944-1973. Environ. Can. Fish. Mar. Serv. Tech. Rep., No.505. iii + 94p. 1974. In English with French summ. SFA 20 (4).



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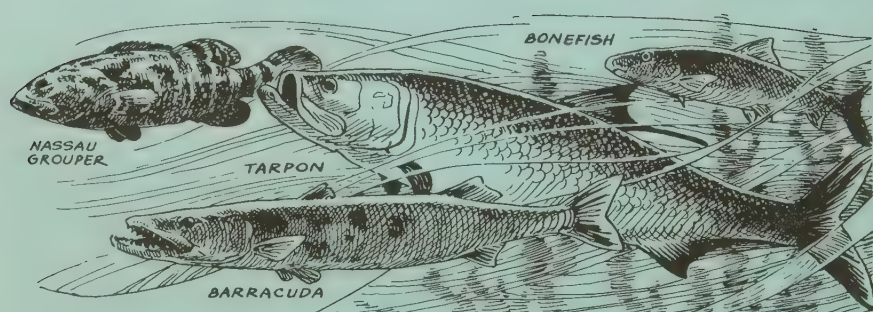
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 - Products - Vibrio
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